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Augmented Containment Inspection Results
Supplement to LPI Reports A12191-R-001 and A12477-R-003

Cooperative Program of Electric Power Research Institute,
Department of Energy, and Constellation Energy Nuclear Group

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ATTACHMENTS

1.0 INTRODUCTION

Lucius Pitkin, Inc. (LPI), working with the US Department of Energy (DOE), Electric Power Research Institute (EPRI), and Constellation Energy Nuclear Group (CENG), developed and performed augmented inspections and testing of the R. E. Ginna Nuclear Plant (Ginna) and Nine Mile Point Unit 1 (NMP1) containment structures.

The objective of the augmented inspection and testing was to supplement the industry's understanding of the potential for long-term operation of concrete containment structures. This report provides a summary of the continuation of the fiber optic tendon monitoring system installed at Ginna from the date of installation to June 11th, 2014. A description of the prior augmented inspections and tests are provided in LPI reports A12191-R-001 [1][1] and A12477-R-003 [2]. The details on selection of tendons, installation, calibration, and evaluation of prior data are not repeated in this report.

2.0 TENDON MONITORING AT GINNA

The tendon monitoring program for Ginna described in LPI reports A12191-R-001 [1] and A12477-R-003 [2] began in 2011. The tendon monitoring progression at the Ginna plant included the following activities:

1. The shims of twenty tendons were instrumented with fiber optic strain gages in March and April 2011. The gages were correlated to the lift-off load during tendon lift-off tests performed in April 2011. Data collection was initiated on April 14, 2011. A structural integrity test (SIT) and integrated leak rate testing (ILRT) were performed on June 1, 2, and 3, 2011. A description of the installation, calibration, and the data results that include the SIT are provided in [1].
2. Data was retrieved on May 8, 2012, which was approximately one year of data. This data was analyzed and the results provided in [1].
3. Data was retrieved on June 25, 2013 at the completion of the second year of data collection. This data was analyzed and the results of the first two years of tendon data were provided in [2].
4. Data was again retrieved on June 11, 2014 at the completion of the third year of data collection. This data was analyzed and the results of the first three years of tendon data are provided in this report.

[1] Numbers in brackets (e.g. [1]) indicate references listed in Section 5.0.

3.0 RESULTS AND ANALYSIS – TENDON MONITORING

This section updates the analysis and conclusions made in the prior reports [1, 2] with additional data recorded after the previous evaluation. The data collected from April 14, 2011 to June 11, 2014 was interrupted by intermittent loss of power to the data acquisition system. This total set of data includes data that was extracted from the data acquisition system (DAS) for the periods from:

- April 14, 2011 to October 12, 2011
- February 28, 2012 to October 24, 2012
- January 9, 2013 to February 12, 2013
- June 7, 2013 to August 22, 2013
- February 21, 2014 to March 2, 2014
- May 14, 2014 to May 20, 2014
- June 3, 2014 to Jun 8, 2014
- June 11, 2014

Details regarding the installation and calibration of the gages are discussed in [1] and [2].

3.1 Tendon Sensor Data

Tendon sensor data from the period of 4/26/11 to 5/31/12, from 6/1/12 to 6/25/13, and from 6/26/13 to 6/11/14 are shown in Figure 3-1a, b, and c respectively. The gaps in the data were caused by loss of power to the DAS that exceeded the capacity of an installed uninterruptable power supply (UPS). These gaps in data are represented as straight lines between the end of a data set and the beginning of a new data set upon restoration of power. Because the gages are fiber optic gages and strain change is determined by wave length change, the loss of power does not have an adverse effect on the accuracy of the data following restart of the DAS.

The data plotted in Figures 3-1 a, b, and c show tendon load, shim temperature, ambient outdoor temperature (HRC_ATG), containment temperature, and containment pressure. The line labeled “HRC_ATG” is the outdoor ambient temperature sensor that is in a conduit, which is shielded from direct solar heating. Temperature (°F) and containment pressure (psig) is shown on the left and the scale for shim load (kips) is shown on the right. A more negative shim load means more compressive, thus a higher tendon load. Tendon relaxation or wire breakage would be seen as less negative shim loads. The lines are labeled with the tendon number. As an example, the line labeled “T51” is the compressive shim load associated with tendon 51.

Detailed plots of tendon data versus time are provided for each tendon in Attachment A.

The outside ambient temperature low and high (measured by the HRC absolute temperature gage ATG) during the evaluation time period was 7.7°F on 2/28/14 and 107.3°F on 7/17/12. This represents a maximum difference in temperature of 99.6°F.

The maximum shim temperature delta for any one monitored tendon during the same time period was approximately 76°F for tendon 131. Solar heating influences shim vent cans that are in direct sunlight.

Figure 3-2 shows the tendon loads plotted over the entire three-year monitoring period. Also shown on this plot is the upper and lower load limit established by the Ginna Station for determination of an acceptable lift-off load during the periodic lift-off tests. The limits established by the Ginna Station are between a low compressive load of -636 kips and high compressive load of -743 kips [1].

The data presented in Figure 3-1 illustrates that the tendon loads over a three-year period have generally been stable and have remained within the load limits for acceptability. Several tendons, specifically 59, 107, T131 and T139, show a trend of increasing compressive load of over 18 kips over the three year period (see Figure 3-12, Figure 3-17, Figure 3-20 and Figure 3-21). This appears to be a drift in the gages, since increasing compressive loads would not be expected. In general, though, fiber optic sensors should not experience drift, so it is recommended that these gages be observed closely in the future. A possible reason for this apparent drift could be eccentricity of the anchor head, unevenness in the shim stack, or other reasons. Further discussion on the factors that may affect shim load is provided in Subsection 3.2 below.

If there was a wire break, a rapid movement to lower compressive loads would be expected. To detect the potential for a wire break, the tendon data was examined to determine a load change of greater than 8 kips per day reduction in load by determining the slope of the data for every 24 hour period. An 8 kips load change is considered appropriate to detect a wire break since this is the approximate load carried by each wire in the tendon bundle. There are no instances where the slope of line was greater than 8 kip per day.

Based on the overall review of the data, it is apparent that there is neither loss of load due to relaxation nor any evidence of wire breakage.

3.2 Individual Tendon Sensor Data

It is difficult to use the data presented in Figures 3-1a, b, and c and Figure 3-2 to review the behavior of individual tendons. For that reason, the data for load and temperature is presented on each individual tendon in Figure 3-5 to Figure 3-23Figure 3-23.

Each tendon has two shim halves that are inserted under the anchor head to provide a path for the tendon load. A fiber optic strain gage and a temperature-compensating gage was placed on each shim half. These were referred to as the “A” side and the “B” side. Each tendon was calibrated by lift-off after installation

of the gages. The tendon load reported is the average of the two gages on each shim half.

Figure 3-5 to Figure 3-23 show individual tendon results. The (a) plot of each of the figures for each tendon shows the average load, the containment temperature, the tendon temperature, the ambient temperature (HRC_ATG), and the containment pressure. The (b) plot of each of the figures for the tendons includes the load that would correlate to the strain measured in the "A" shim, the load that would correlate to the strain measured in the "B" shim, and the tendon load that represents the average of the two-shim halves. These data are plotted versus time representing the entire three years of data recorded.

The loads in the (a) plot are compared to load limits that were used at the Ginna plant. At the time of the tendon lift-off testing, the tendon load was specified to be not less than -636 kips and not more than -734 kips [1].

A change in the data over a three-year period is provided for each tendon. This comparison is for data collected in June for three consecutive years from 2011 to 2014. The days in June of each year where containment temperature is similar (approximately 100°F) were selected for this comparison (6/24/2011, 6/6/2012, 6/25/2013, and 6/6/2014). The outside ambient temperature is also close for these days (80°F±3°F).

The detailed evaluation of individual tendon and individual shim data with a load resolution that is less than 1 kip provides an opportunity to observe the interaction of the individual shim behaviors with each other and with temperature. This also provides an opportunity to observe the stability of each individual gage.

The tendon system is complex and the measured shim strain can be influenced by the following characteristics: A detailed review of small changes in load needs to consider these possible effects.

1. **Tendon configuration** – Some tendons such as T3, T35, T115, T123, and T139 pass around containment penetrations such as the personal and equipment hatch (see Figure 3-3). As such, these tendons are curved around the penetrations. The behavior of curved tendons versus straight tendons can influence the load. Curved tendons are longer as it has to pass around the penetration. The curved portion would exert a lateral bearing force against the penetration. Also depending on the size of penetration, there may be multiple curved tendons adjacent to each other. The wire bundles associated with curved tendons most likely will be bearing on one side on the inner diameter of its conduit. These configuration differences between curved and straight tendons are likely to influence the behavior of the tendons and shim load.
2. **Unevenness in the shim stack** – The shim stack is comprised of two main shim halves to which the strain gages are attached. On top of the main shim stack are a series of small shims that make up the gap required to maintain the desired tendon load. The mating surfaces of the shim stack may not be completely even with high and low points such that the transfer

of load through the shim stack may not be linear at the point to which the strain gage is attached. A photo of the T139 tendon head is shown in Figure 3-4 as an example showing the shim stack up.

3. **Location and size of tendon head relative to the shim stack** – The tendon head is smaller than the shim stack and following lift-off testing the placement of the head may not be perfectly concentric to the shim stack. The location and eccentricity of the head relative to the shim stack may influence the strain and hence the load measurements. See Figure 3-4 as an example.
4. **Tendon locations around the containment** – Tendons location around the containment may respond differently since some cans are shaded from the sun more than others. Also the envelope of other building structures may influence the tendon response.
5. **Strain gage construction** – Fiber optic strain gages are made from glass that is highly sensitive to temperature. Compensation for temperature effects are made algebraically using the values read by the temperature compensating gages (TCG). However, the influence of the TCG may over or under compensate the total measured strain used to obtain the mechanical strain due to the variables discussed above.

To fully understand the behavior of the measured tendon loads on an ongoing basis, the above variables need to be evaluated to determine the influence on shim strain and associated tendon load.

A continuing process is recommended to assess the accuracy of individual gages and the appropriateness of maintaining each gage in the sample. The evaluation of every individual tendon and shim should consider the tendon-to-tendon features that are described above. In the tendon-by-tendon evaluation that follows, several individual gages on individual shims exhibit changes that appear to be drift and therefore affect the reported load. All the gages are included in the current evaluation, but the tendon-by-tendon evaluation should be continued in the future to assure that any gages that show excessive drift or instability are excluded.

The following is a description of the data for each tendon. The plots for each tendon are contained in Figure 3-5 to Figure 3-23.

Tendon 3: The “B” side shim of tendon 3 had higher strains (more compression) than the “A” side. The average tendon load during the three year period changed by -0.49%. A negative percentage of change represents a relaxation of the tendon and a reduction in the tension on the tendon wires.

Tendon 11: The “A” side shim of tendon 11 had essentially the same strain as the “B” side. The average tendon load during the three-year period was changed by 0.89%. A positive percentage of change represents an increase in the compression on the shim and an increase in the tension on

the tendon wires. The tendon load increased at times that the temperatures were increasing and generally varied with the temperatures.

Tendon 19: The “A” side shim of tendon 19 had higher strains than the “B” side. The average tendon load during the three year period was changed by 0.41%. The load during the period had very little variation.

Tendon 27: The “B” side shim of tendon 27 had higher strains (more compression) than the “A” side. The average tendon load increased by approximately 25 kips in the first six months of monitoring. This was caused by an increase in the strain on the “B” shim. The “A” shim was generally flatter. The average tendon load during the three year period was changed by 0.47%.

Tendon 35: The “A” side shim of tendon 35 had a slightly higher strain than the “B” side. The tendon load increased at times that the temperatures were increasing and generally varied with the temperatures. The average tendon load during the three year period was changed by 1.08%.

Tendon 43: The “A” side shim of tendon 43 had a slightly higher strain than the “B” side. The tendon load increased at times that the temperatures were increasing and generally varied with the temperatures. The average tendon load during the three year period was changed by 0.75%.

Tendon 51: The “A” side shim of tendon 51 was only slightly higher than the “B” side. The tendon load decreased slightly at times that the temperatures were increasing. The average tendon load during the three year period changed by -0.72%. This tendon had the largest reduction of tendon load.

Tendon 59: The “B” side shim of tendon 59 was somewhat higher than the “A” side. The tendon load changes followed the temperature changes. The average tendon load during the three year period was changed by 4.18%. This is one of the larger percentage changes. This represents an increase in compression. This percentage change is due to a change in the “A” side shim load. If only the “B” side shim load was used, the load change would be 2.51%.

Tendon 67: The “A” side shim of tendon 67 had essentially the same strain as the “B” side. The average tendon load during the three year period was changed by 0.77%.

Tendon 83: The “B” side shim of tendon 83 was only slightly higher than the “A” side. The average tendon load during the three year period was changed by 0.31%.

Tendon 91: The “A” side shim of tendon 91 was higher than the “B” side with a large difference between the two. The average tendon load during the three year period was changed by 0.65%.

Tendon 99: The “A” side shim of tendon 99 had a much higher strain than the “B” side. The tendon load changes generally followed the temperature

changes. The average tendon load during the three year period was changed by 1.14%.

Tendon 107: The “B” side shim of tendon 107 had higher strains than the “A” side. The B-side exhibited some anomalous behaviors. Changes on the “B” side affected the average load. The average tendon load during the three year period was changed by 4.46%. This was an increase in the compressive load. If only the “A” side was used, the load change was 1.36%.

Tendon 115: The “B” side shim of tendon 115 had larger strains than the “A” side with a large difference between the two. The average tendon load during the three year period was changed by 1.38%.

Tendon 123: The sensor that was on the “B” side of tendon 123 was erratic and was not used. The “A” side strain was used to monitor the load. The average tendon load during the three year period changed by -0.15%.

Tendon 131: The “B” side shim of tendon 131 had larger strains than the “A” side at the beginning of the period. They moved closer together midway through the three year period. The average tendon load during the three year period was changed by 2.69%, and it represents an increase in compression.

Tendon 139: The “B” side shim of tendon 139 had larger strains than the “A” side. The average tendon load during the three year period was changed by 6.02%. This was an increase in compression on the tendon. The change in the average tendon load is largely controlled by an increase in the load on the “B” shim. If only the “A” side of the tendon were used, the load change would be -0.48%.

Tendon 147: The “B” side shim of tendon 147 had larger strains than the “A” side. A change on the “B” shim that occurred in mid-year of 2012 caused a change in the average. The “A” shim did not change at the time that the “B” shim changed. The average tendon load during the three year period changed by -0.65%.

Tendon 155: The “B” side shim of tendon 155 had somewhat larger strains than the “A” side. The load over the period is relatively stable and flat. The average tendon load during the three year period changed by -0.01%.

3.3 Composite Tendon Sensor Data Comparison

A comparison of data collected in June for three consecutive years from 2011 to 2014 was performed and presented in Table 3-1. As previously noted, this comparison was made using the June data (6/24/2011, 6/6/2012, 6/25/2013, and 6/6/2014) of each year when the containment and outside ambient temperature were similar. For the three years, the containment temperature was approximately 100°F±5°F and the outside ambient temperature was 80°F±3°F.

From Table 3-1, it can be seen that 5 tendons (tendons 3, 51, 123, 147, and 155) show a reduction in compressive load. All the changes are less than -0.72%. A

reduction in compressive load would indicate relaxation of the tendon or wire breakage; however, the observed small changes suggest that there is no evidence of significant relaxation or wire breakage. All the other tendons exhibited increases in the compressive loads, which indicate an increase in the tendon wire tension. The largest change was in tendon 139, which changed by +6.02%. This 6% change was influenced by the "B" side shim load. If only the "A" side shim load was used, the load change would be -0.48%. Given that there is no clear mechanism that would cause an increase in tendon loads and that only the "B" shim was affected, this may be evidence of drift in the gage. Such shims should be evaluated as additional data is taken. If the drift continues, it may be acceptable to use only the "A" shim for this tendon. Tendons 59 and 107 had changes of more than 4.0%. These tendons also had larger changes in one of the shims and should also be evaluated as more data is received.

The primary concern for the tendons is loss of prestress in the concrete. These results show that the loss of prestress is limited to five tendons and the change of load is small. These conclusions are favorable for the use of fiber optics to monitor tendon load in place of lift-off testing and provide confidence that the containment remain prestressed at the designed level.

3.4 Containment Rebar and Concrete Strain Monitoring

Figures 3-24a, b, and c show the rebar and concrete strain data along with the rebar temperature and the temperature and pressure inside containment from 4/26/11 to 5/31/12, from 6/1/12 to 6/25/13, and from 6/26/13 to 6/11/14 respectively. The temperature and pressure scale is on the left and the scale on right indicates strain in micro-strain. Attached to the circumferential rebar are a strain gage, temperature compensating gage (Rebar_TCG), and an absolute temperature gage (Rebar_ATG). The response during the structural integrity test (SIT) can be clearly seen in Figures 3-24a.

The data indicates that the rebar and concrete containment wall had a strain of approximately 203 με and 274 με, respectively when the containment was pressurized to 59.8 psi in June 2011. These measured strain values are consistent with analysis for partially cracked reinforced concrete as discussed in [1]. Since the SIT, the containment rebar and concrete strains have been stable and have generally followed the rebar temperature profile.

The strain plots for the rebar and concrete in Figures 3-24a, b, and c show that the rebar strain increases and decreases with the temperature recorded at the rebar (Rebar_ATG) and the ambient temperature (HRC_ATG). The concrete strain shows similar behavior. The concrete gage was compensated for temperature with the rebar temperature gage. The concrete gage has a stand-off from the concrete and the concrete gage temperature will be slightly different than the rebar temperature. The temperature gages for the rebar and the concrete do not experience the same extremes as the tendons as they are in a room in the auxiliary building that is adjacent to the containment.

The Micron Optics Inc. (MOI) concrete gage that was installed did not have an integral temperature-compensating gage. Advances have been made in the MOI product line to include a temperature-compensating gage in the concrete strain gages. MOI now recommends installing a protected surface mounted or embedded temperature compensating gage to properly adjust for temperature. These advances should be considered for future applications.

4.0 SUMMARY AND CONCLUSIONS

The tendon, rebar, and concrete strain gage instrumentation provided a baseline for monitoring that can be used for continued monitoring. The response of the tendons and the concrete during the pressurization test was consistent with analyses that were performed. The change in tendon loads from 2011 to 2014 showed that the tendon loads were acceptable at the end of the monitoring period. All tendon loads were within the upper and lower limit established in [1].

This demonstration project showed that the fiber optic sensors are generally stable and provided meaningful data on the loads in the tendons. Several gages showed behavior that appeared to be drift and should be evaluated as additional data becomes available. It is suggested that maintaining the augmented monitoring could be used to develop a regulatory position that is capable of replacing the lift-off testing of the tendons.

5.0 REFERENCE

1. Lucius Pitkin Inc. Report No. A12191-R-001, “Augmented Containment Inspection Results,” Revision 0, September 2012.
2. Lucius Pitkin Inc. Report No. A12477-R-003, “Augmented Containment Inspection Results, Supplement to LPI Report A12191-R-001,” Revision 0, September 2013.

Table 3-1: Change in Shim Loads
(Comparison between June 2011 and June 2014)

Tendon #	Change from June 2011 to June 2014	
	Load Change (kips)	Load Change (%)
3	-3.5	-0.49
11	6.3	0.89
19	3.0	0.41
27	3.3	0.47
35	7.6	1.08
43	5.5	0.75
51	-4.8	-0.72
59	29.1	4.18
67	5.3	0.77
83	2.1	0.31
91	4.4	0.65
99	7.7	1.14
107	30.4	4.46
115	9.3	1.38
123	-1.0	-0.15
131	18.6	2.69
139	41.4	6.02
147	-4.7	-0.65
155	-0.1	-0.01

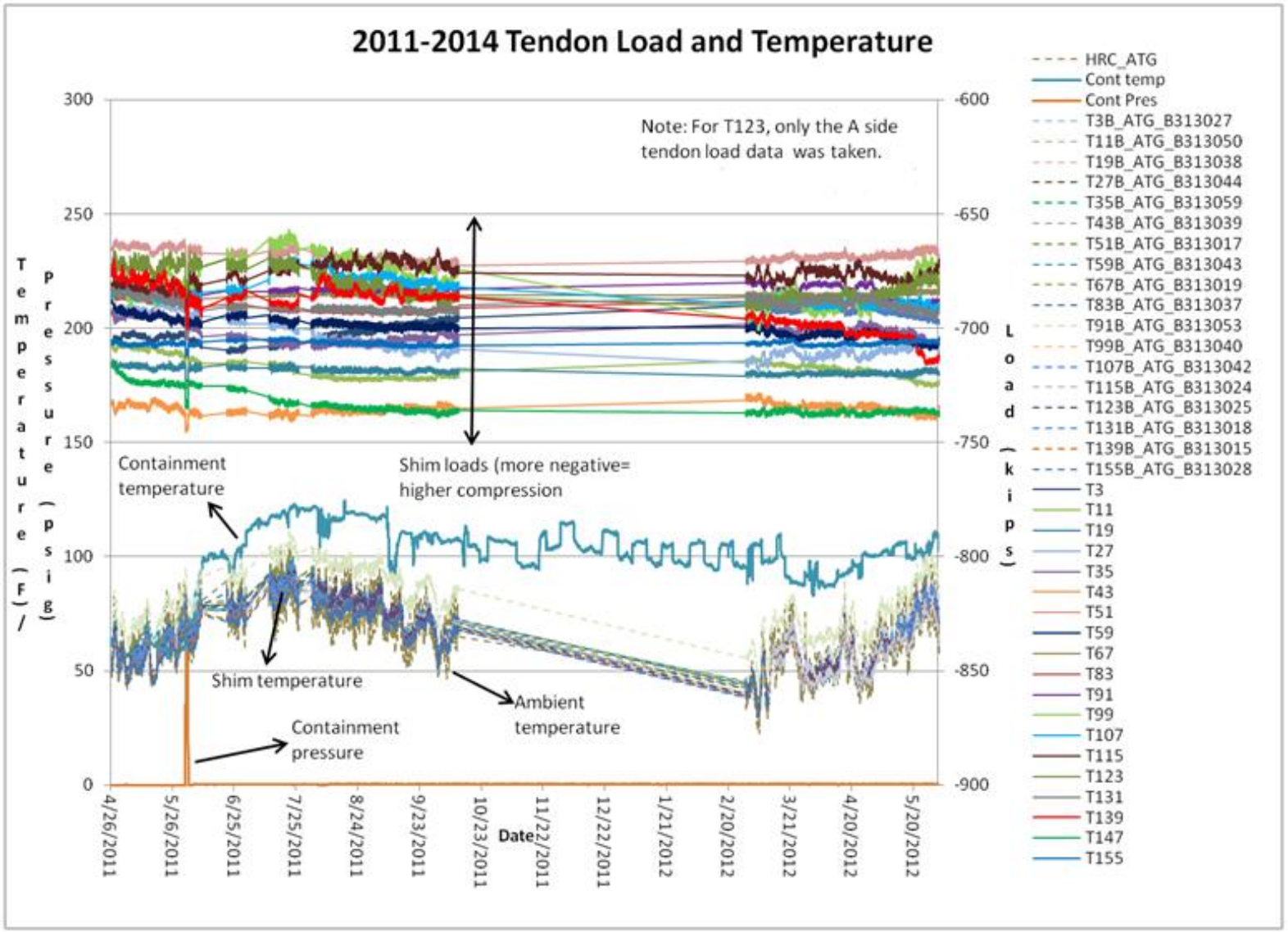


Figure 3-1a: Tendon Data from 4/26/11 to 5/31/12

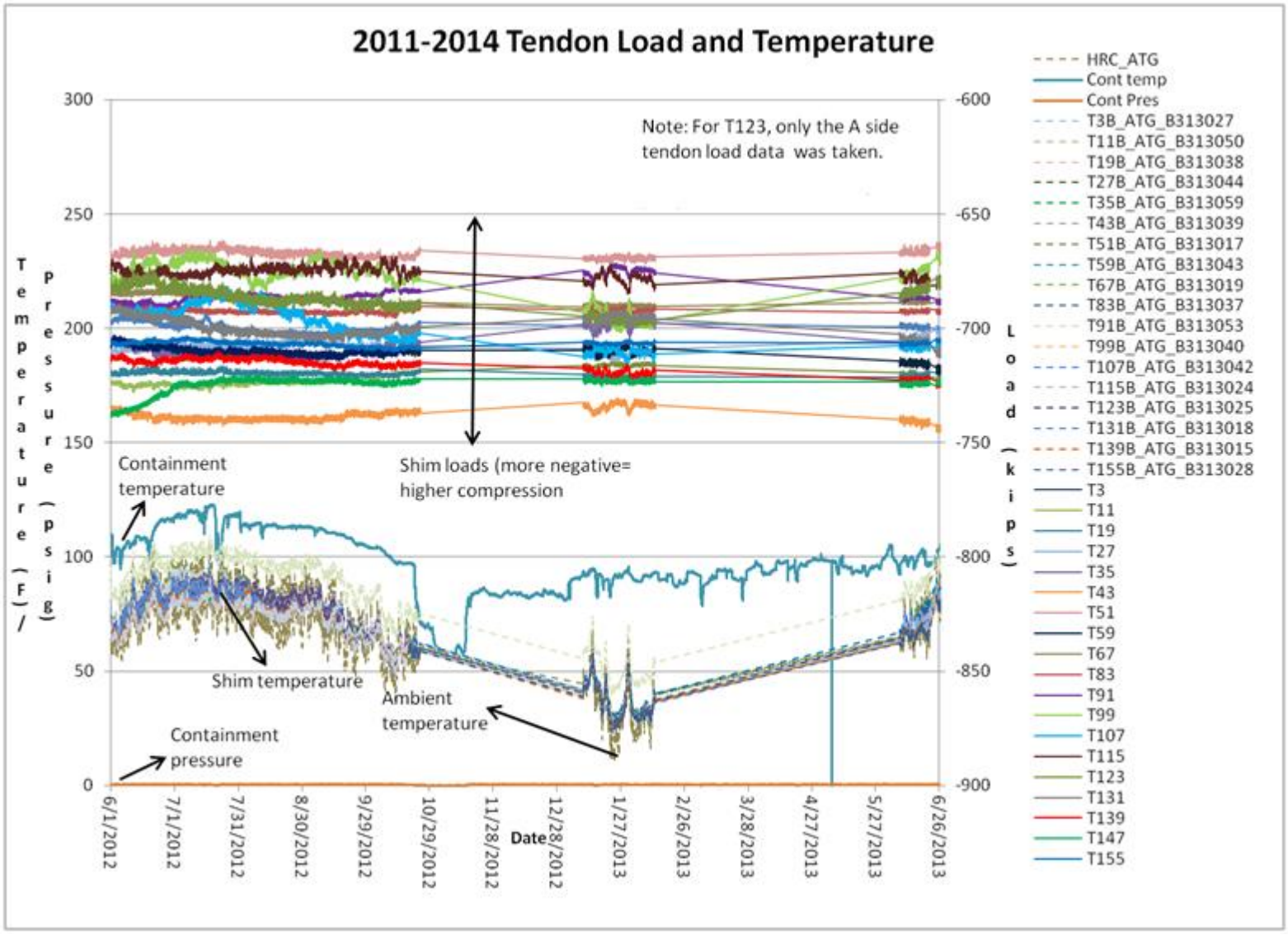


Figure 3-1b: Tendon Data from 6/1/12 to 6/25/13

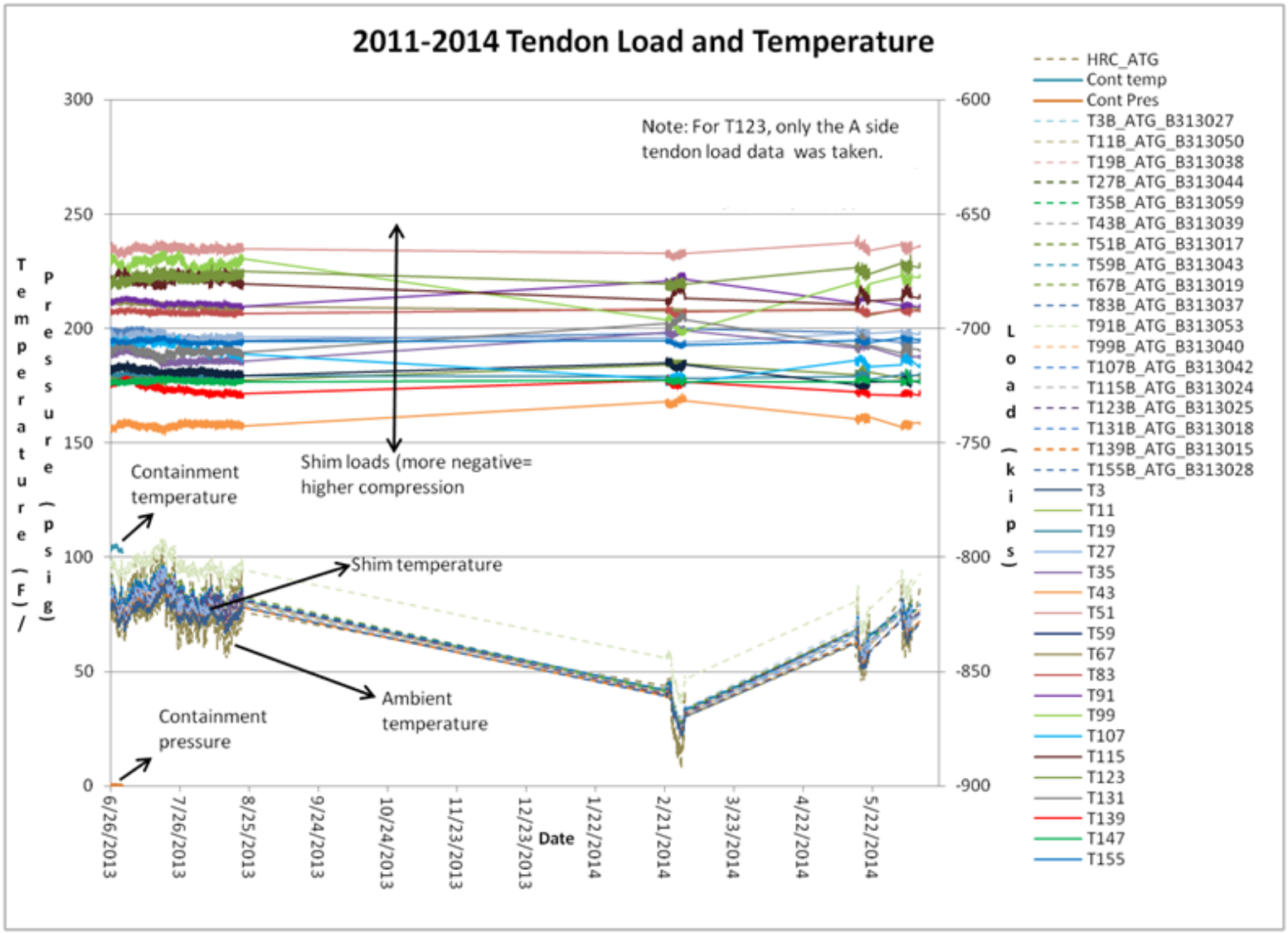


Figure 3-1c: Tendon Data from 6/26/13 to 6/11/14

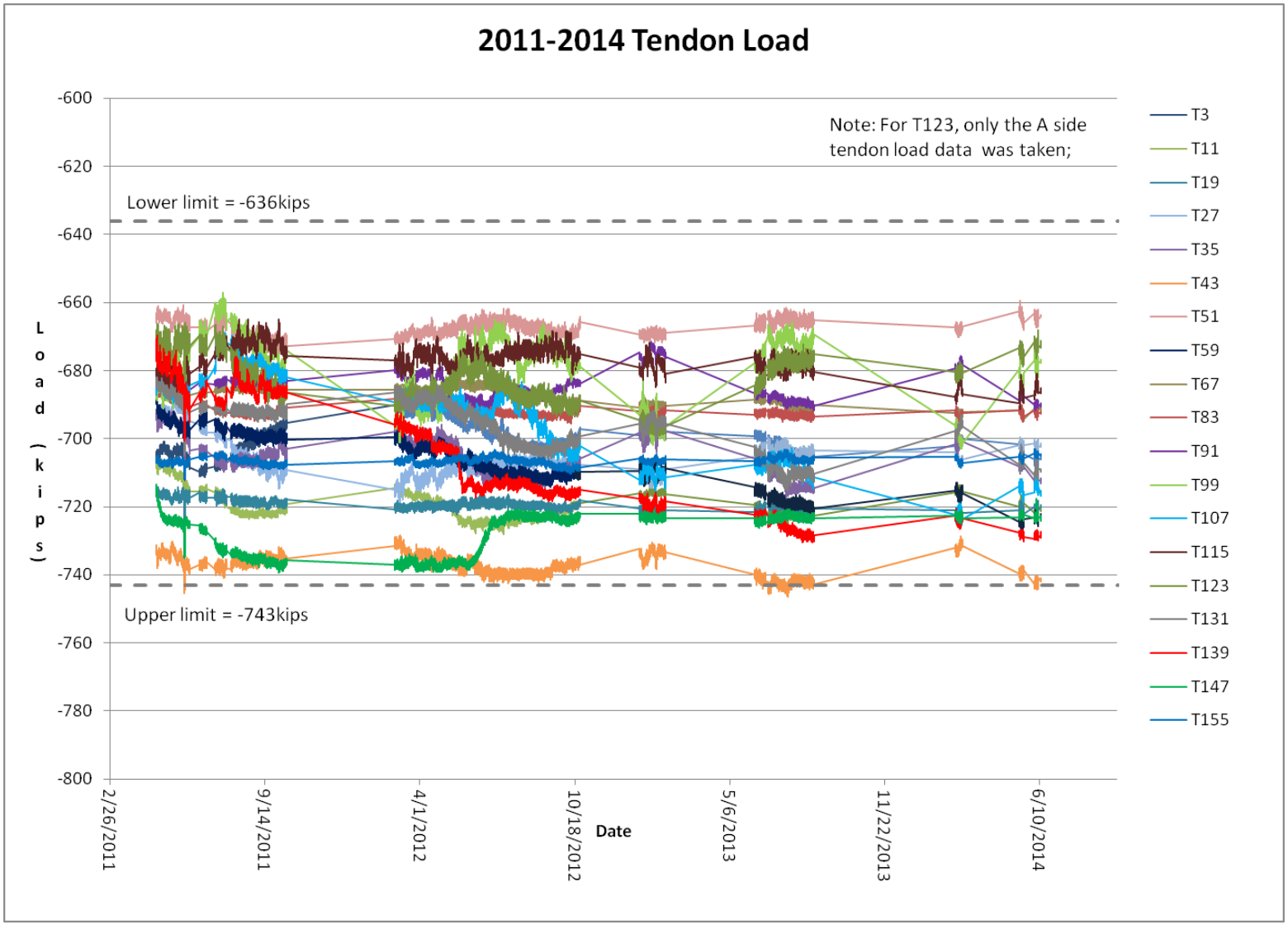


Figure 3-2: 2011-2014 overall tendon loads with lift off load limits used at the Ginna Station

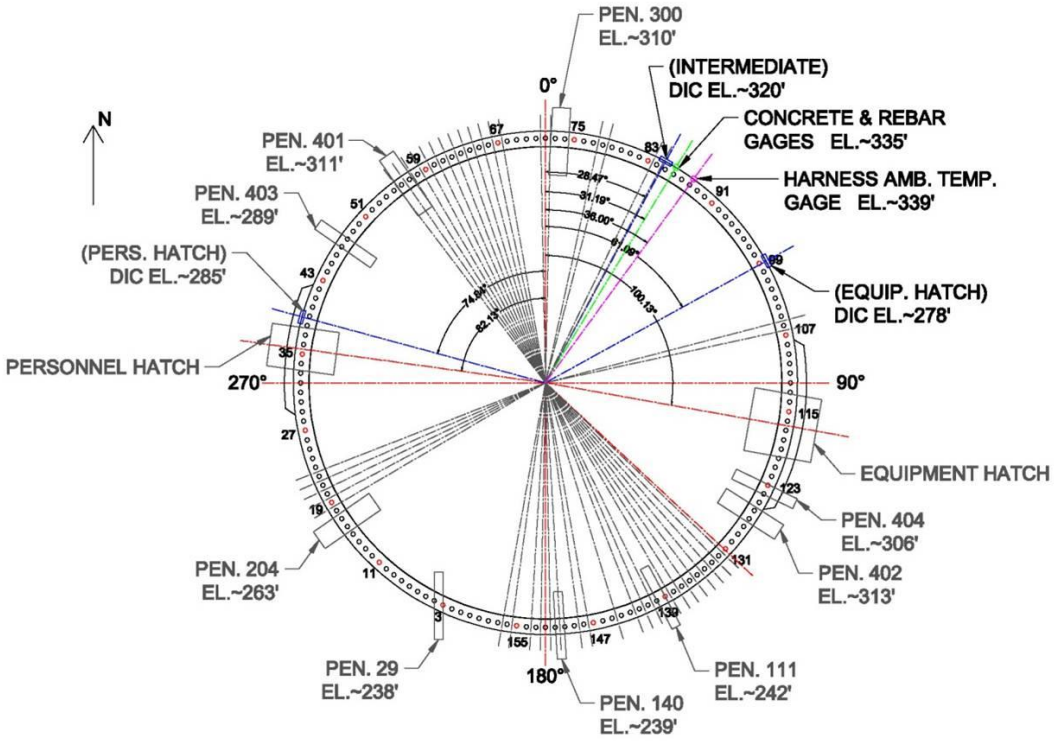


Figure 3-3: Penetration Locations

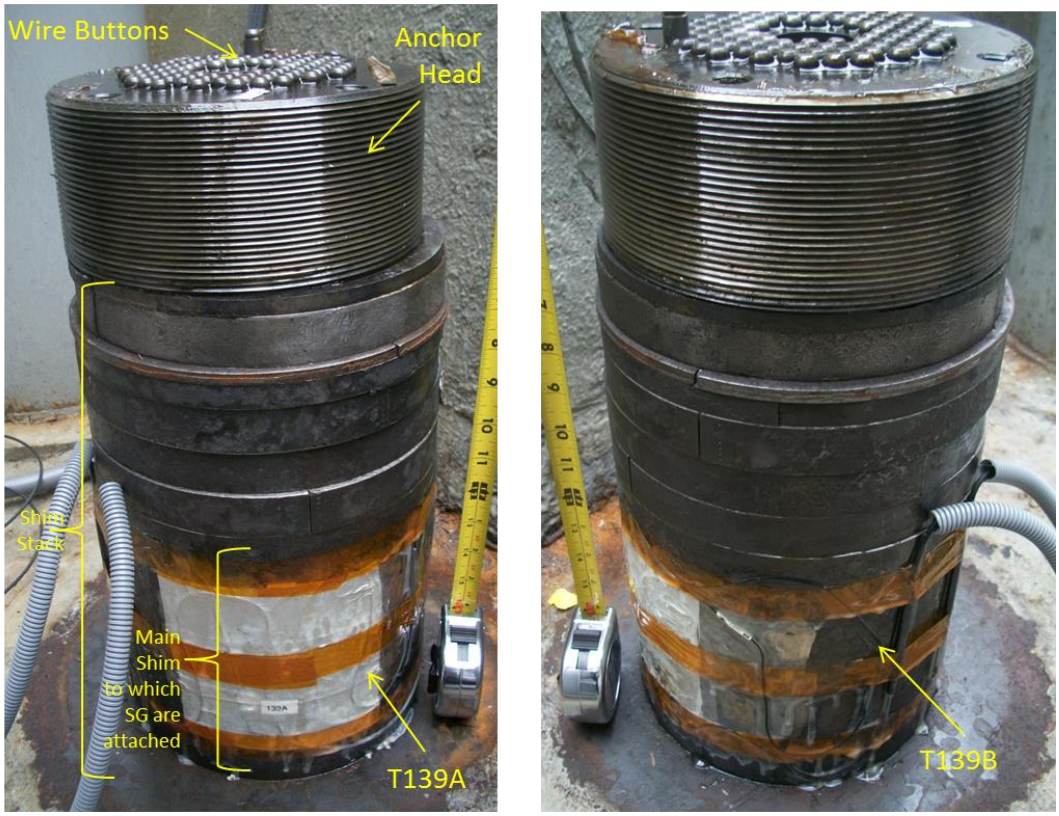
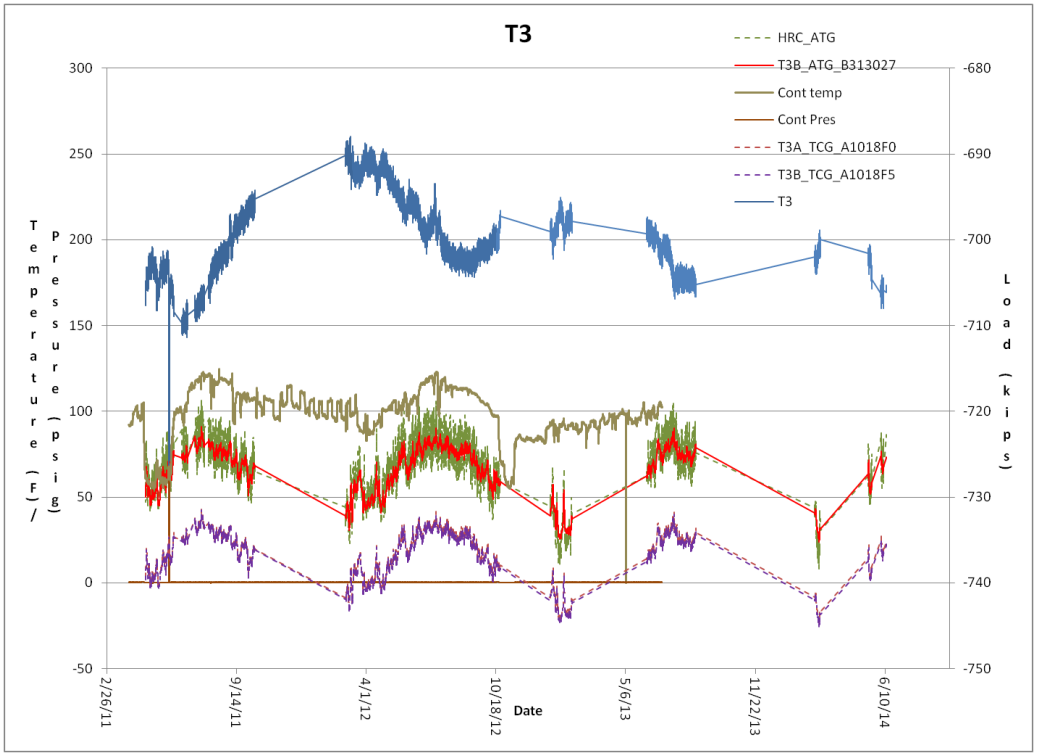
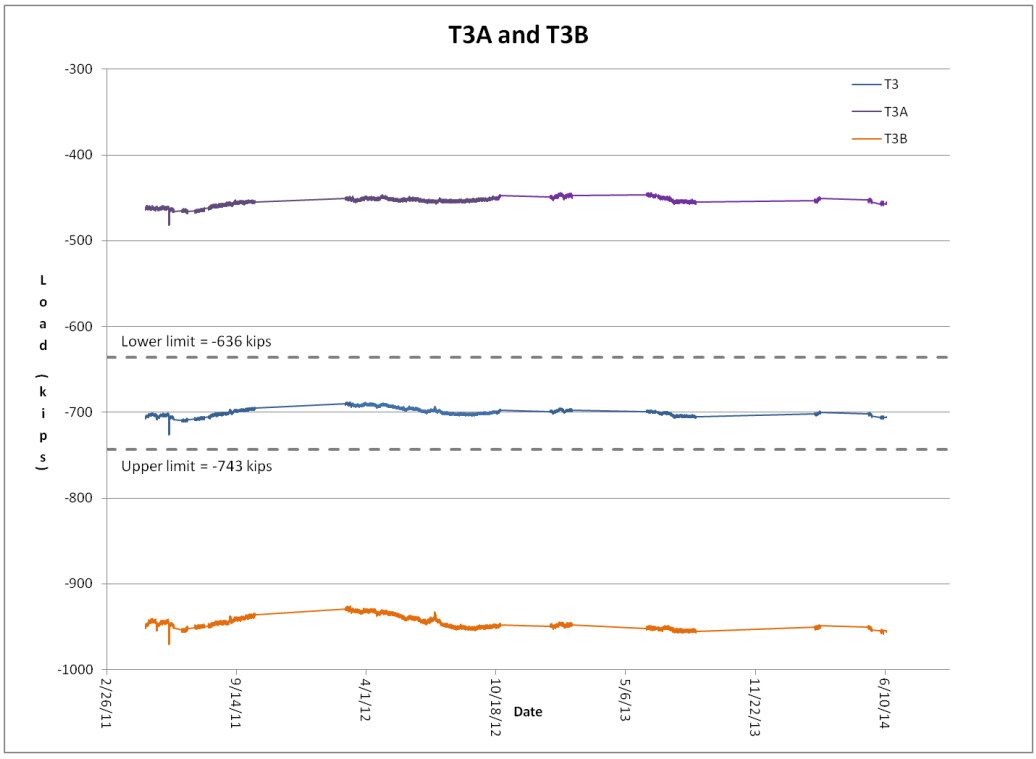


Figure 3-4: T139 Tendon Head

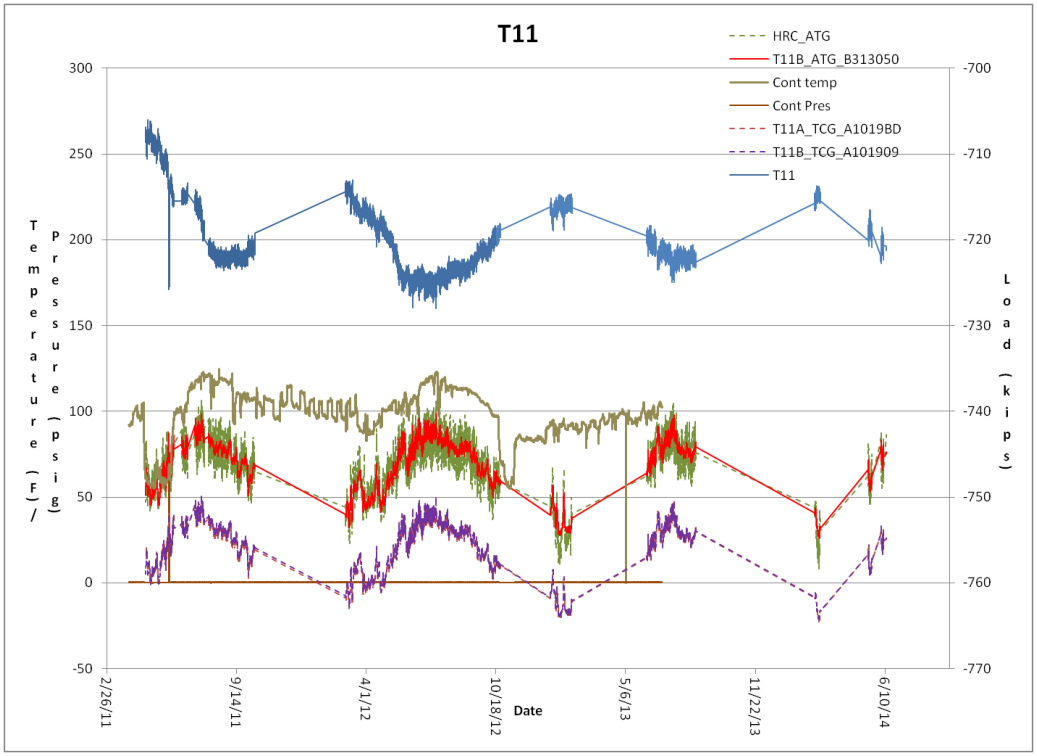


(a) Tendon load and temperature variation over three years

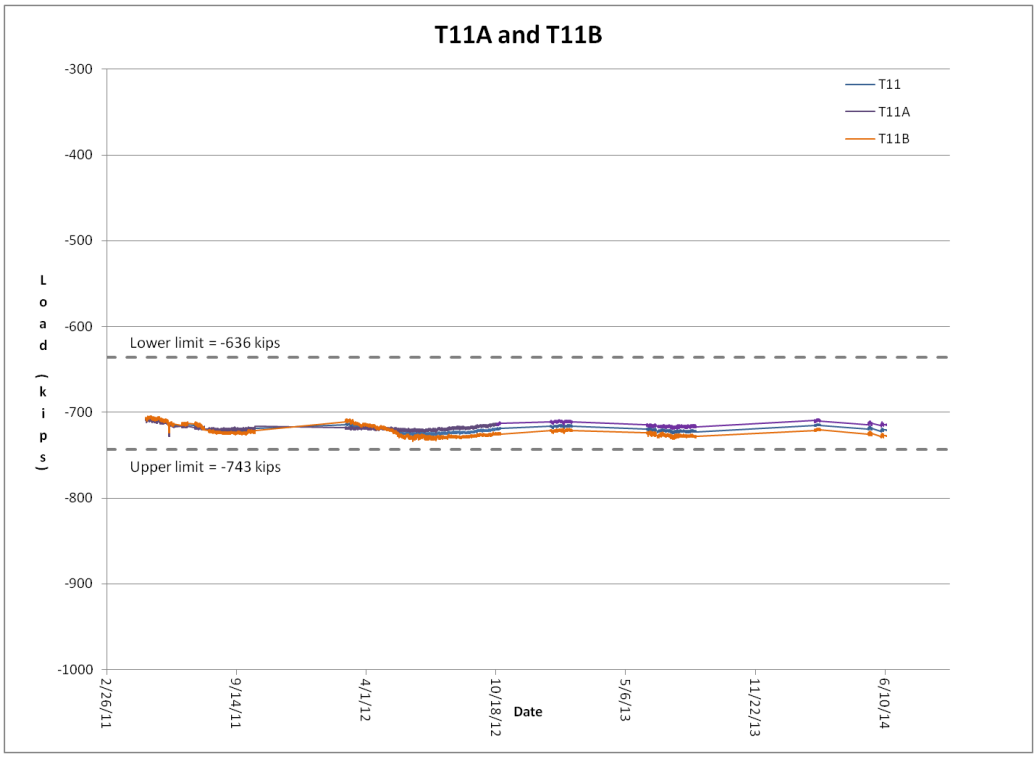


(b) Tendon shim loads and tendon load over three years

Figure 3-5: Tendon 3 Load and Temperature

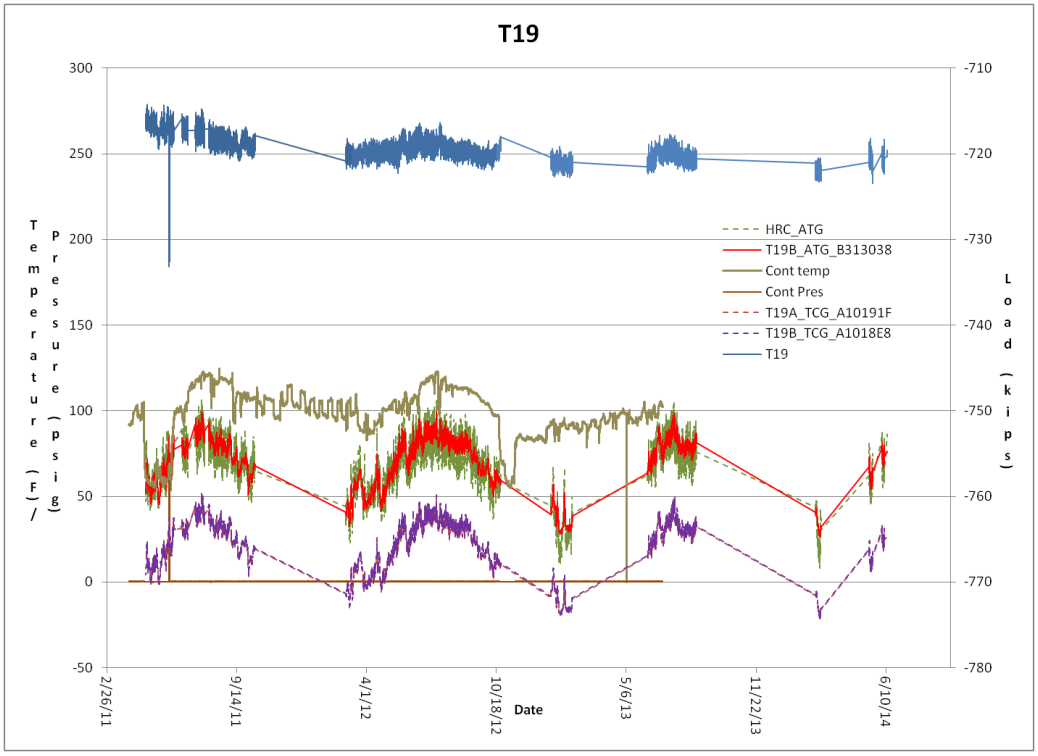


(a) Tendon load and temperature variation over three years

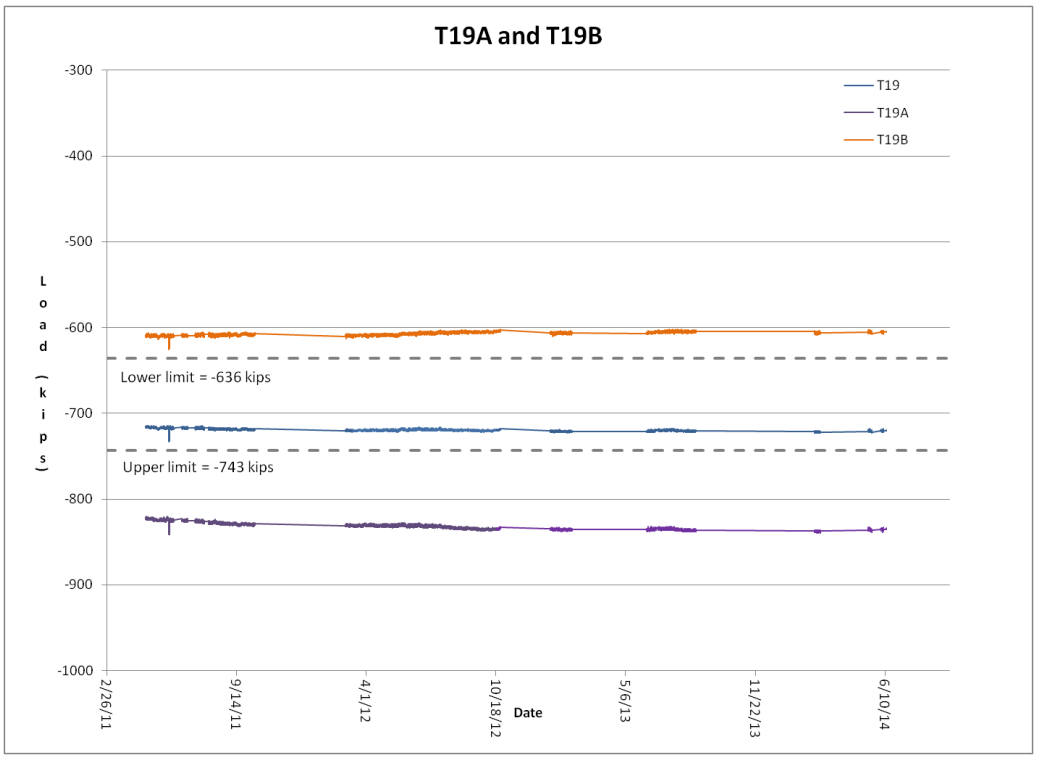


(b) Tendon shim loads and tendon load over three years

Figure 3-6: Tendon 11 Load and Temperature

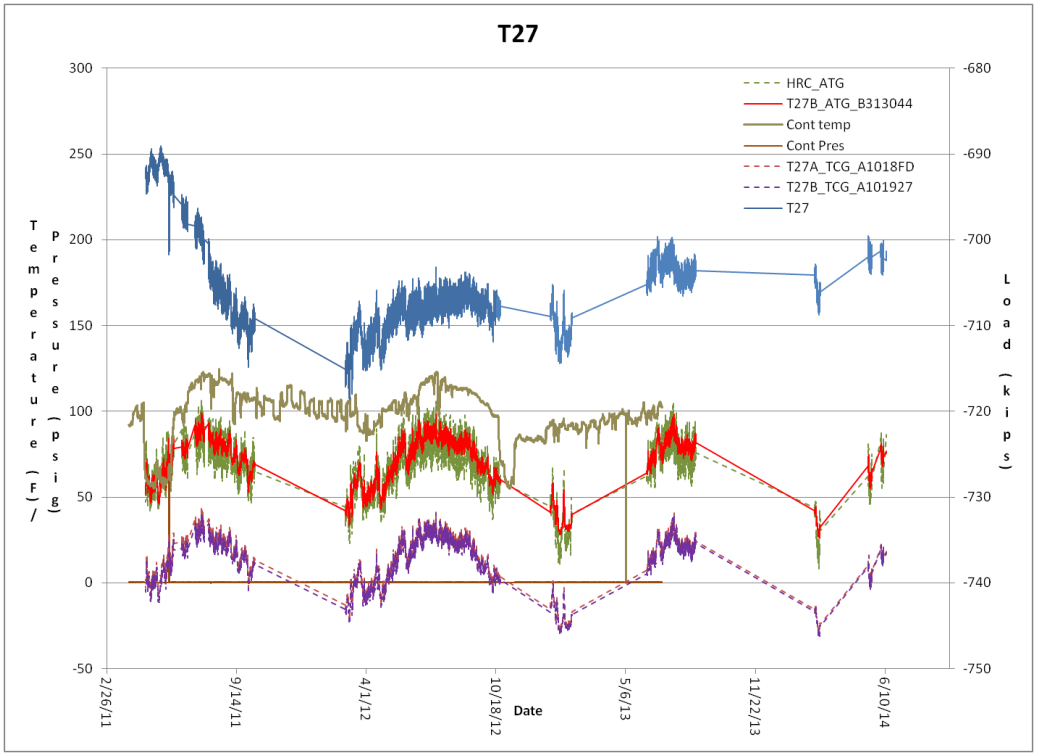


(a) Tendon load and temperature variation over three years

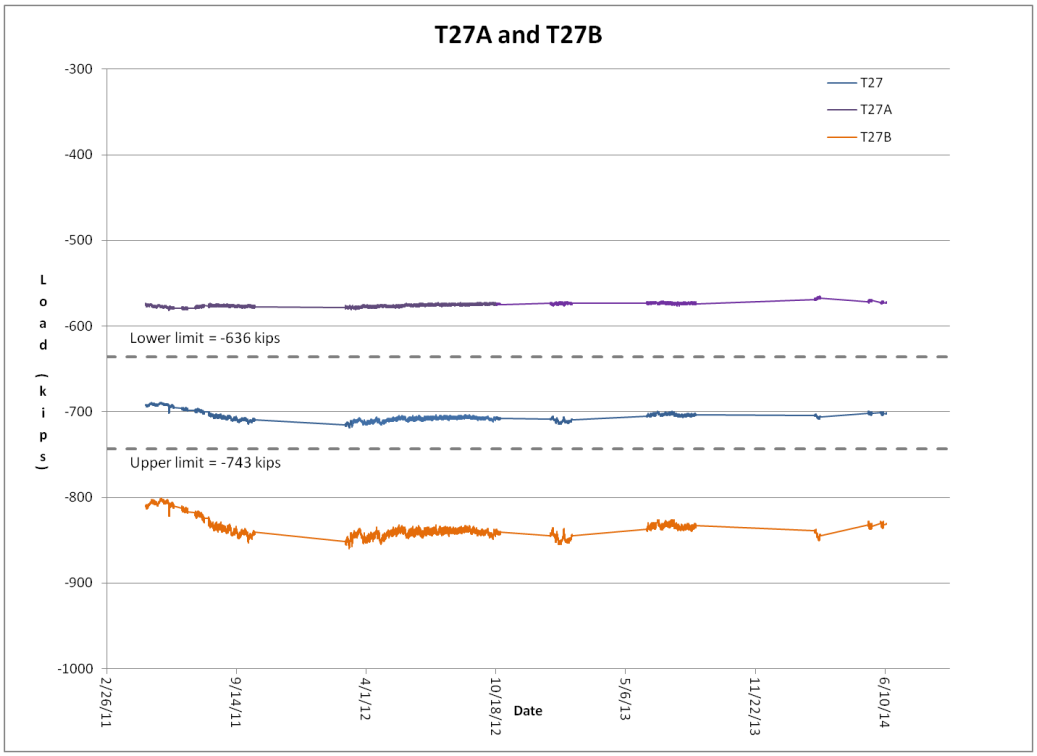


(b) Tendon shim loads and tendon load over three years

Figure 3-7: Tendon 19 Load and Temperature

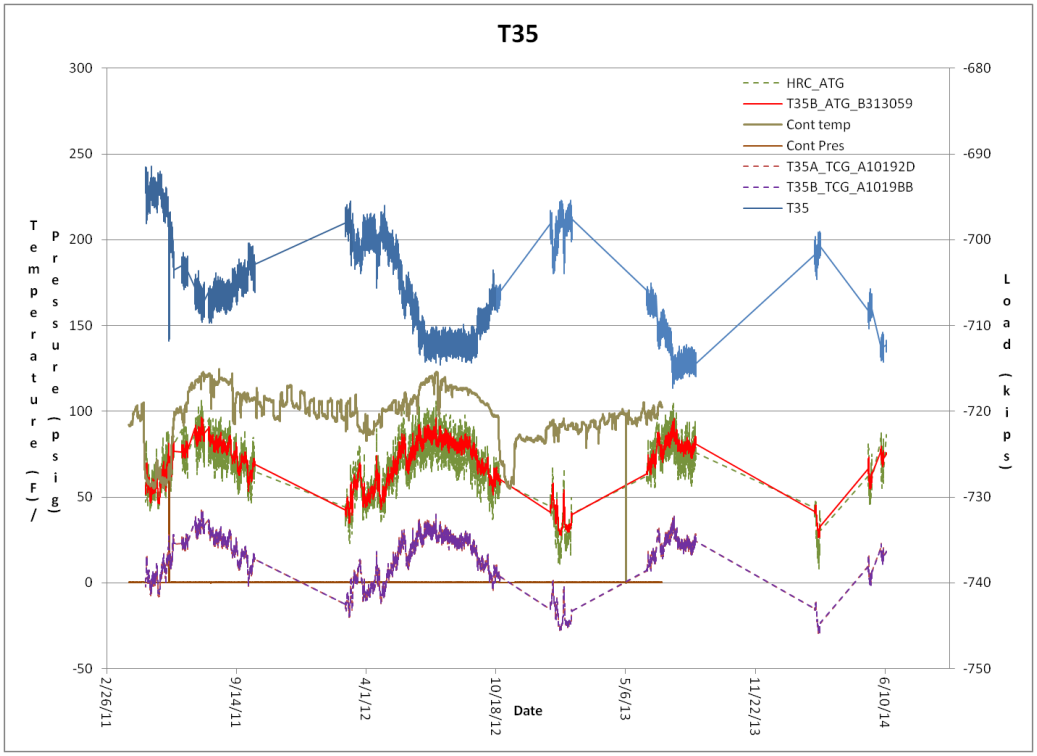


(a) Tendon load and temperature variation over three years

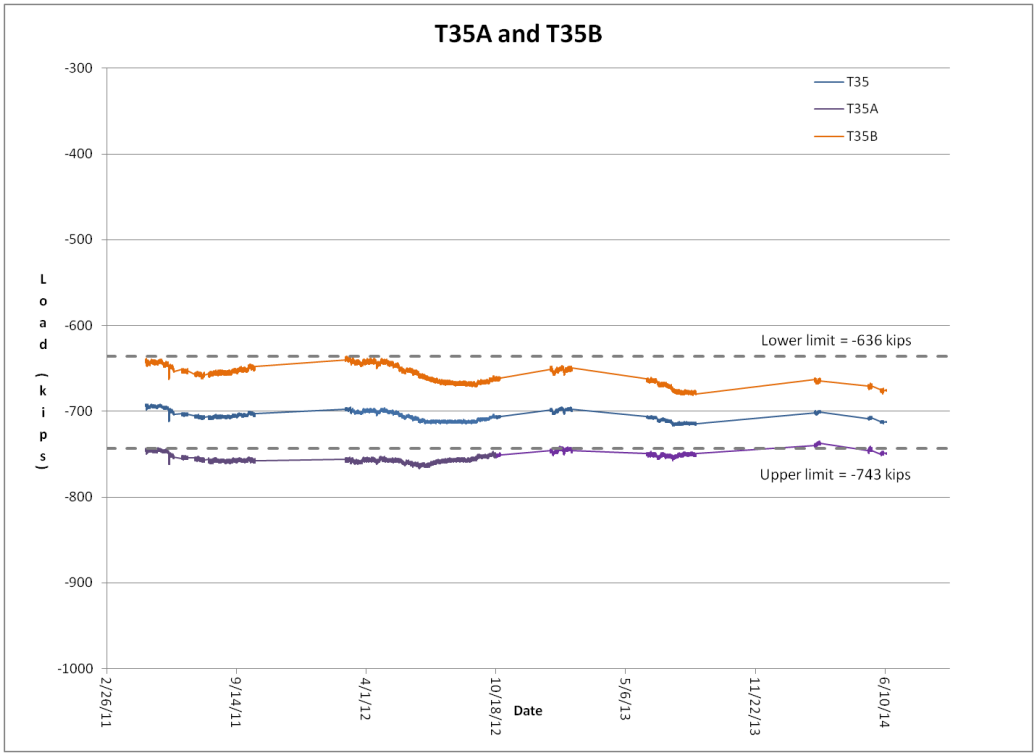


(b) Tendon shim loads and tendon load over three years

Figure 3-8: Tendon 27 Load and Temperature

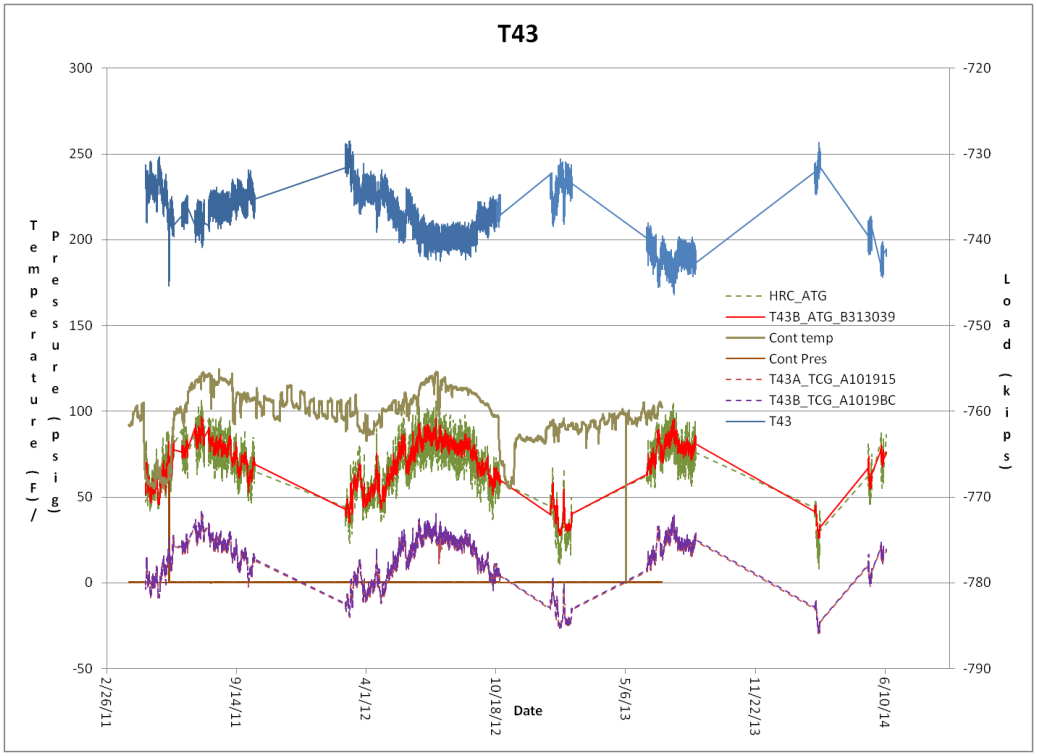


(a) Tendon load and temperature variation over three years

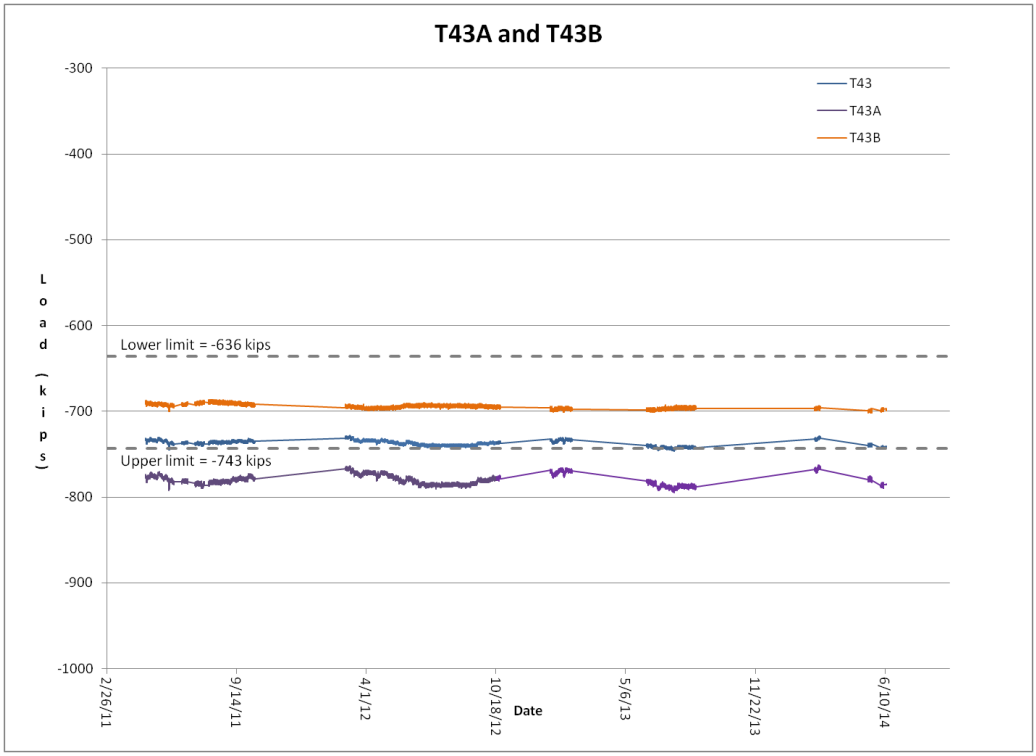


(b) Tendon shim loads and tendon load over three years

Figure 3-9: Tendon 35 Load and Temperature

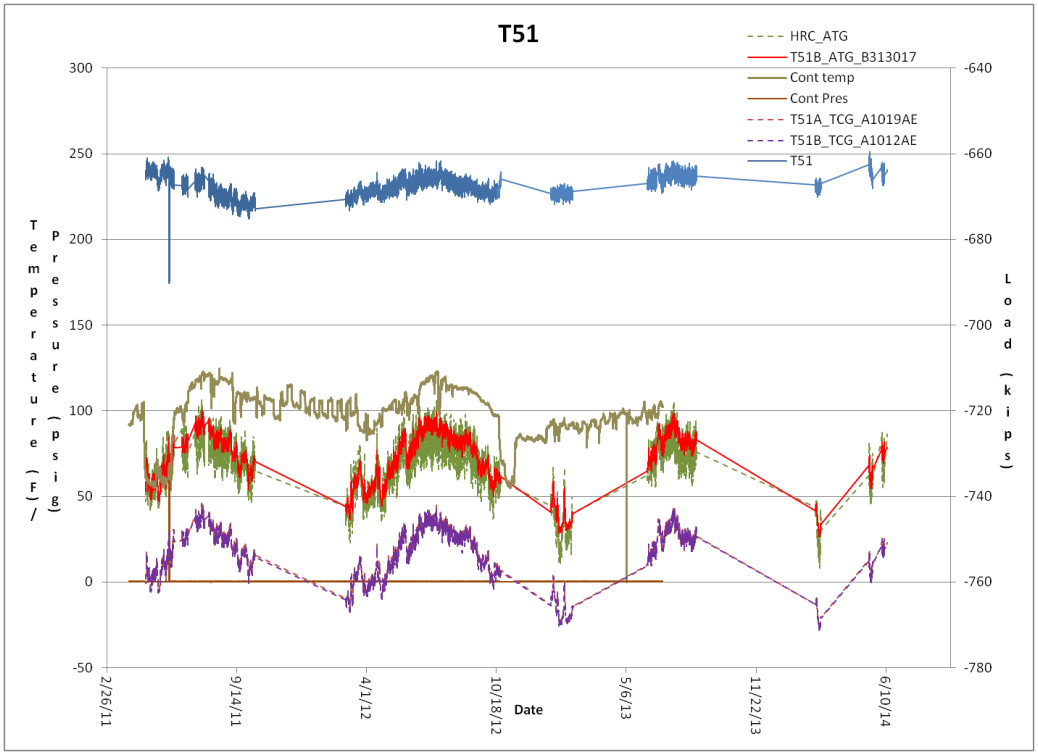


(a) Tendon load and temperature variation over three years

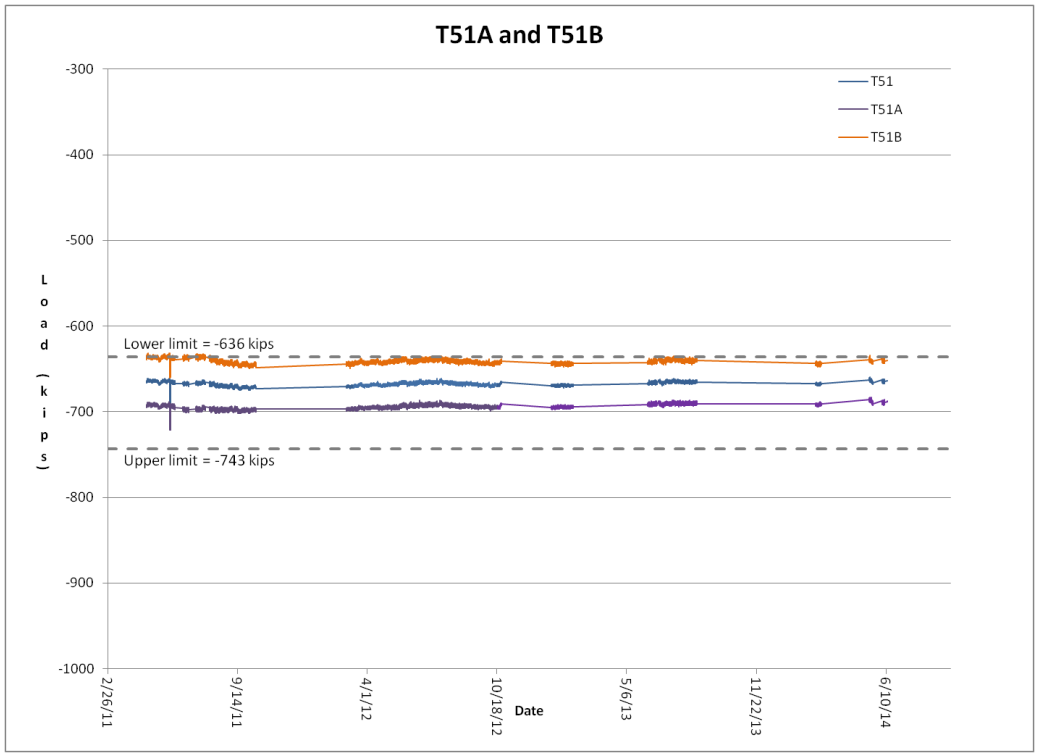


(b) Tendon shim loads and tendon load over three years

Figure 3-10: Tendon 43 Load and Temperature

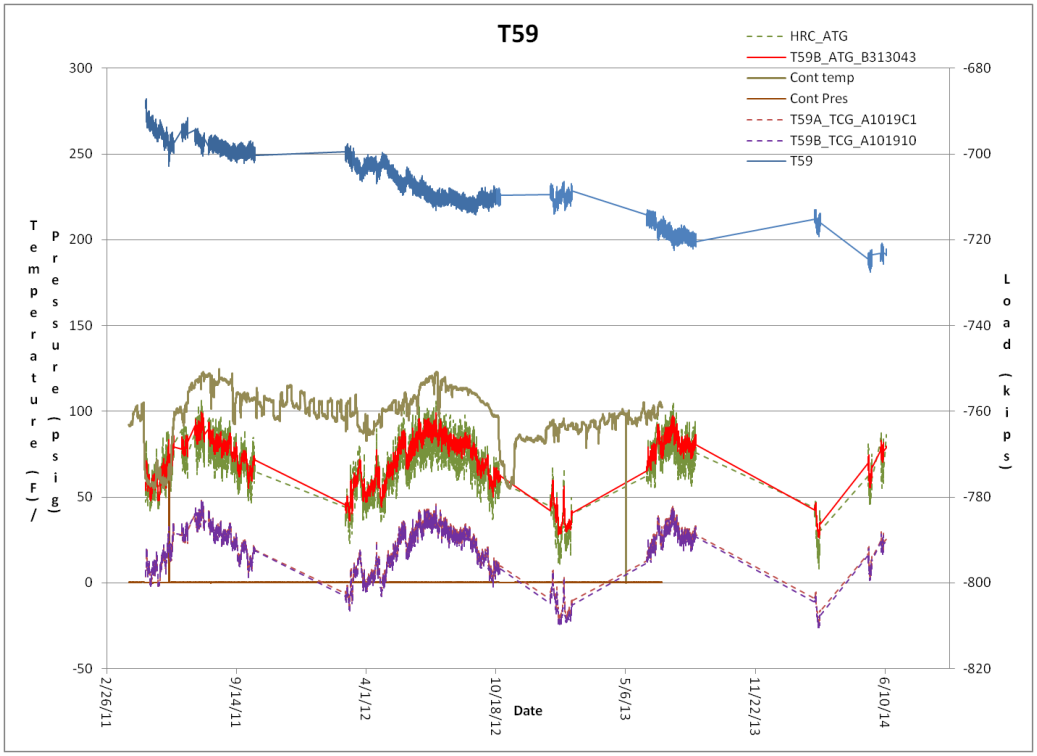


(a) Tendon load and temperature variation over three years

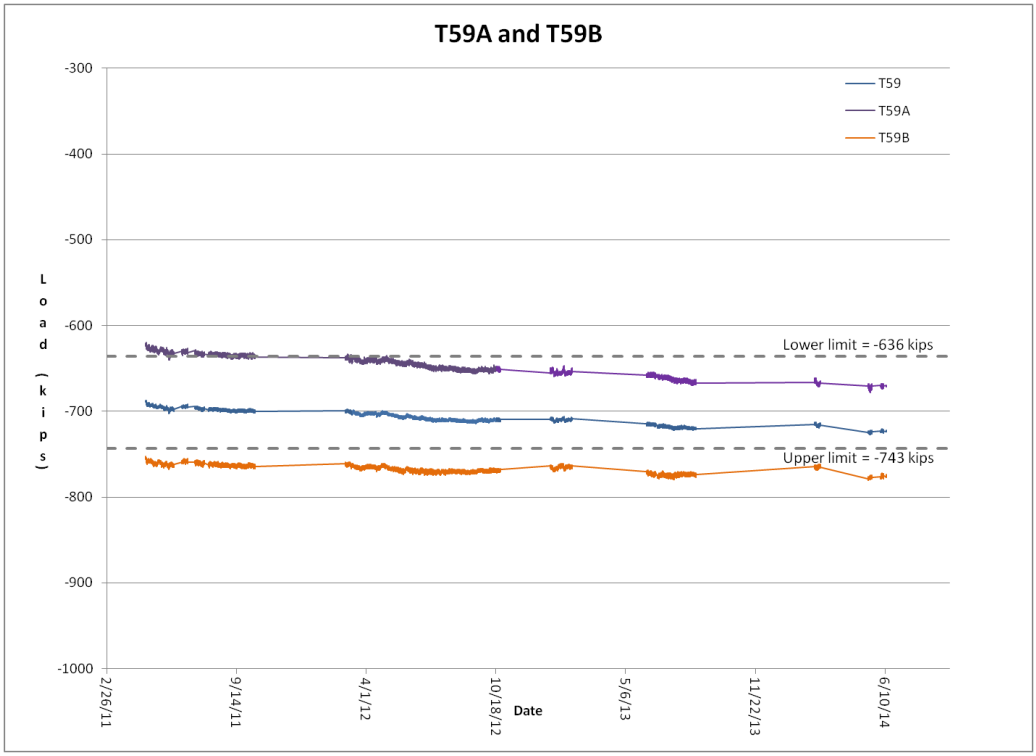


(b) Tendon shim loads and tendon load over three years

Figure 3-11: Tendon 51 Load and Temperature

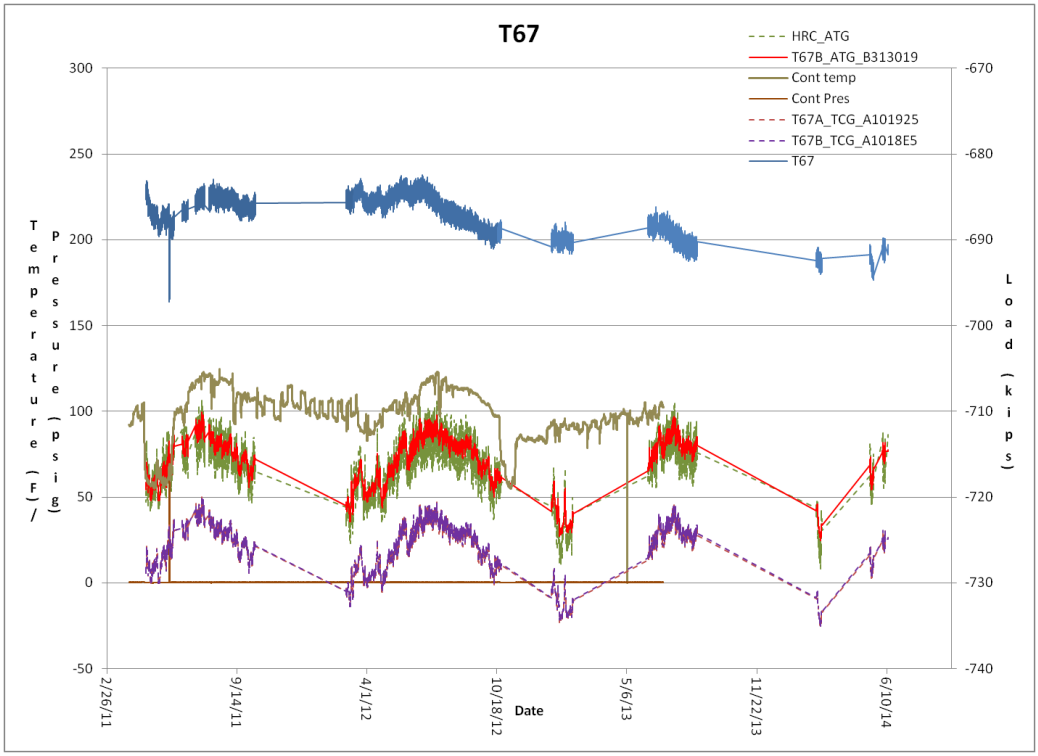


(a) Tendon load and temperature variation over three years

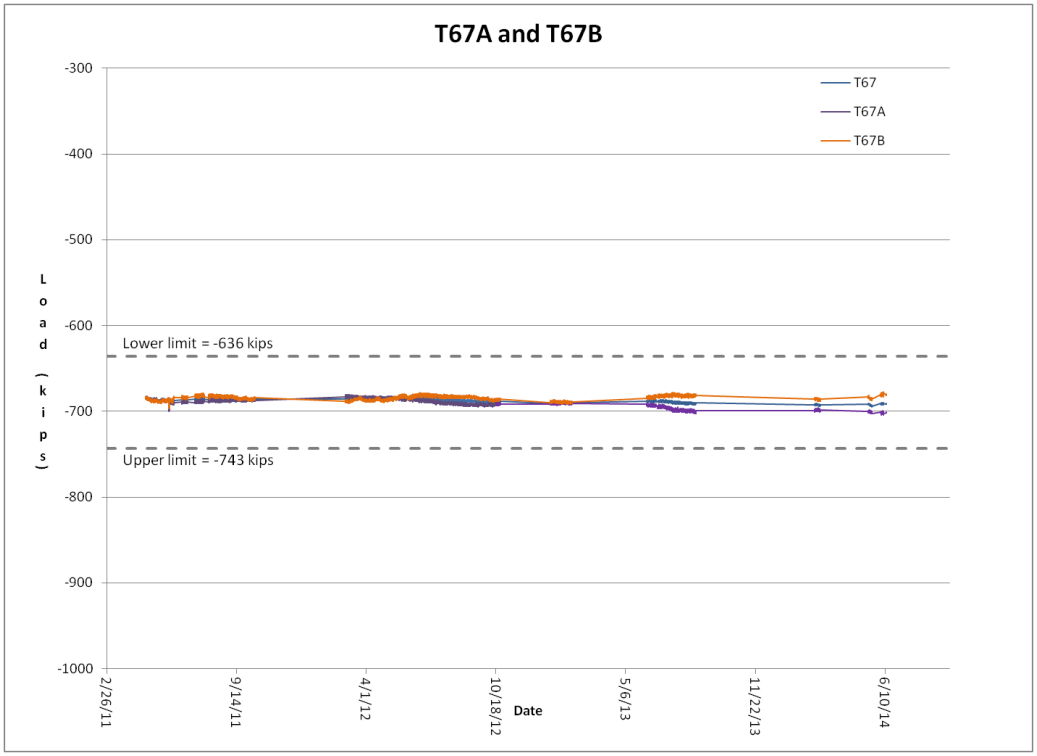


(b) Tendon shim loads and tendon load over three years

Figure 3-12: Tendon 59 Load and Temperature

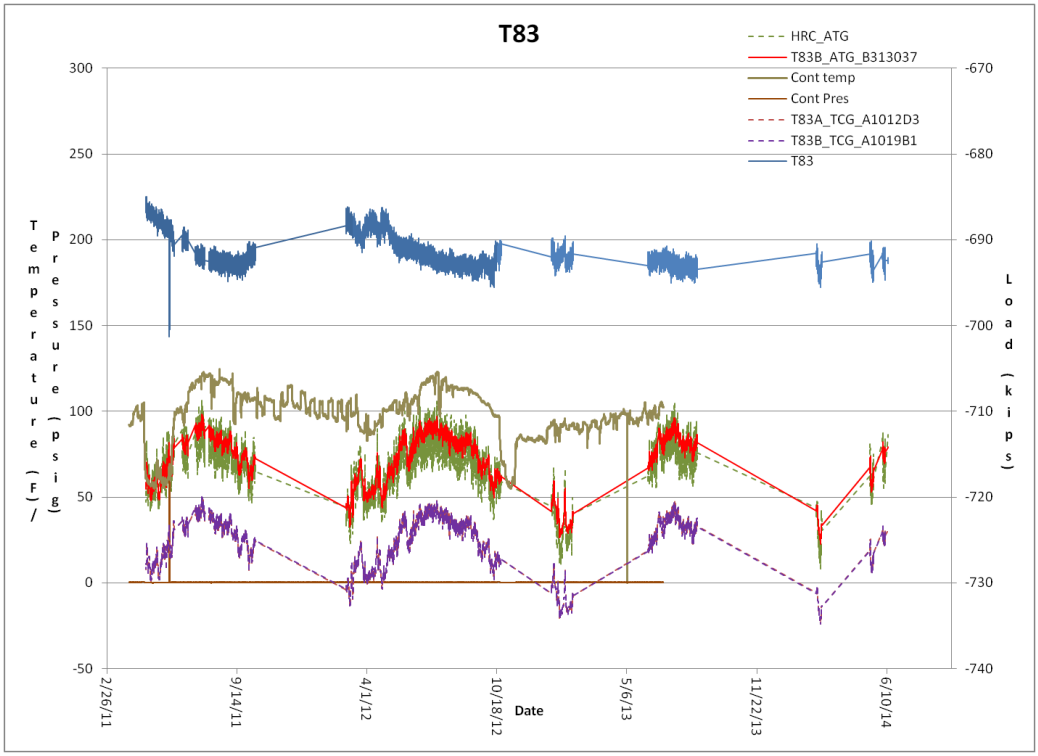


(a) Tendon load and temperature variation over three years

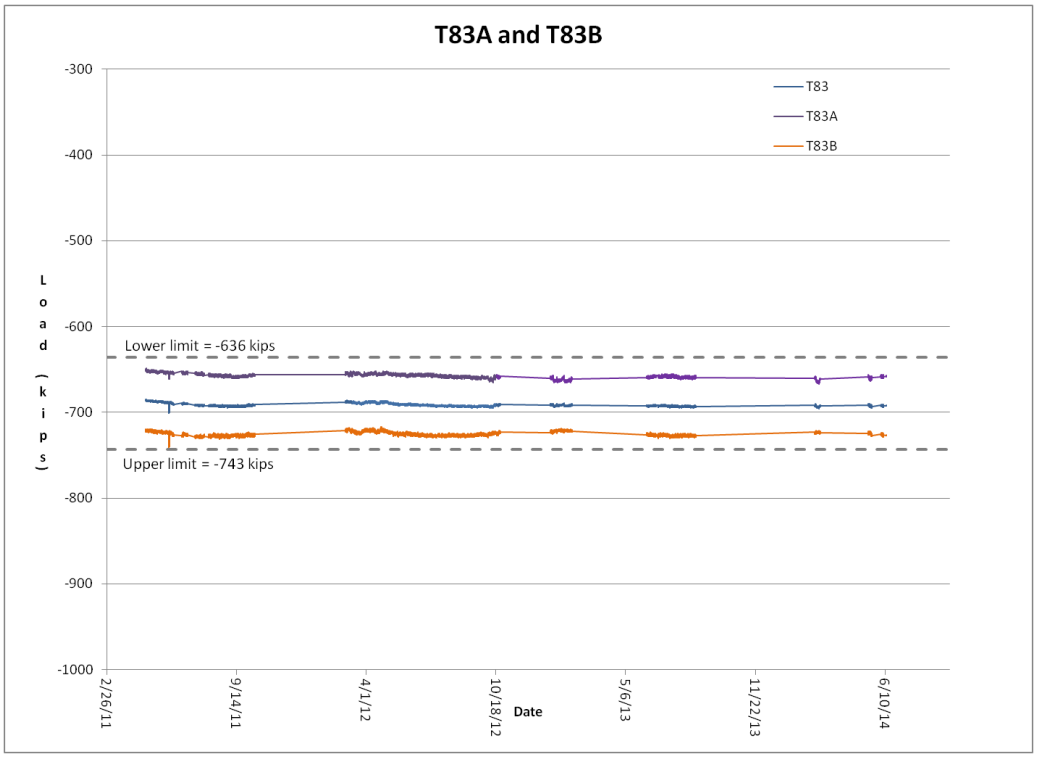


(b) Tendon shim loads and tendon load over three years

Figure 3-13: Tendon 67 Load and Temperature

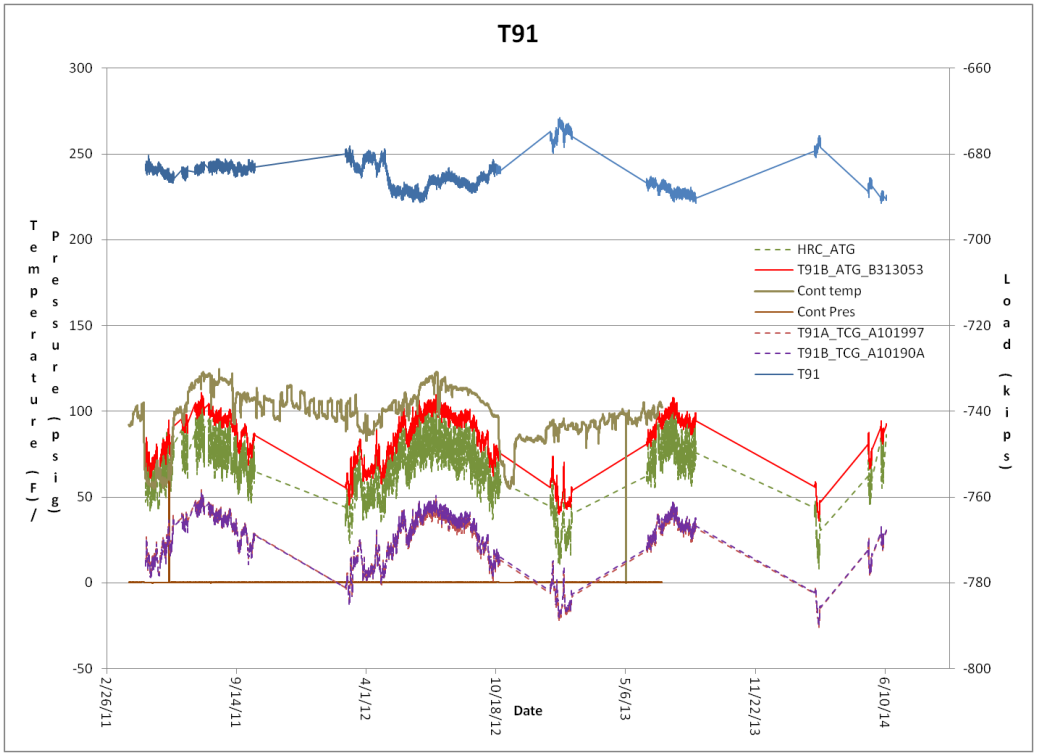


(a) Tendon load and temperature variation over three years

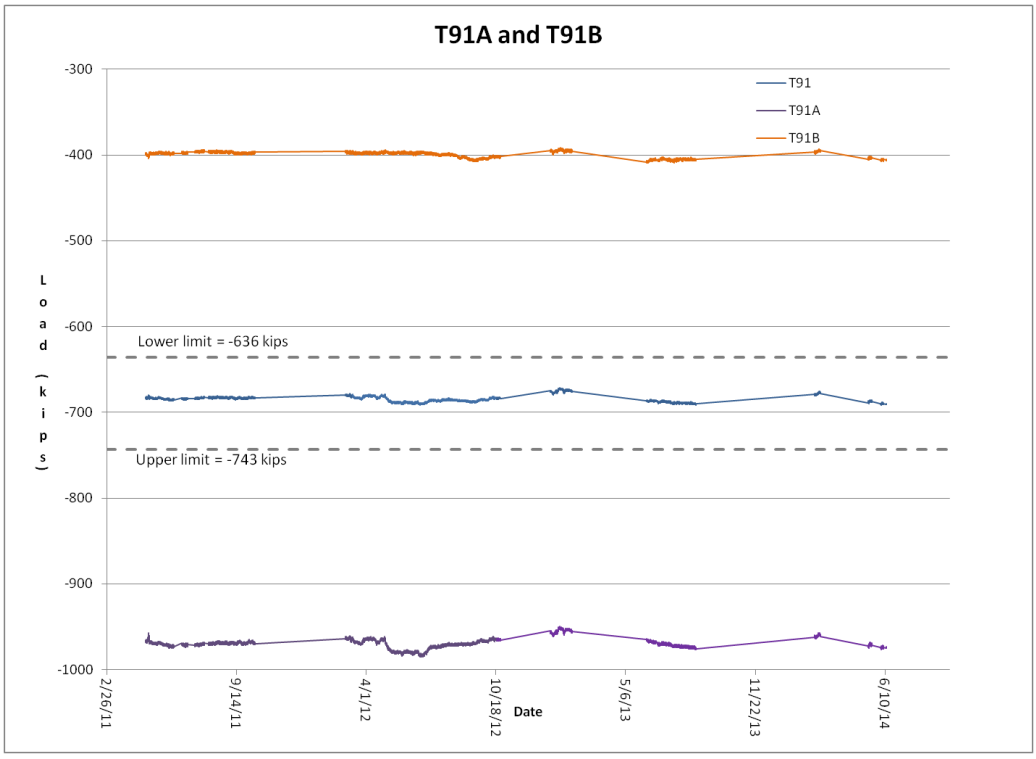


(b) Tendon shim loads and tendon load over three years

Figure 3-14: Tendon 83 Load and Temperature

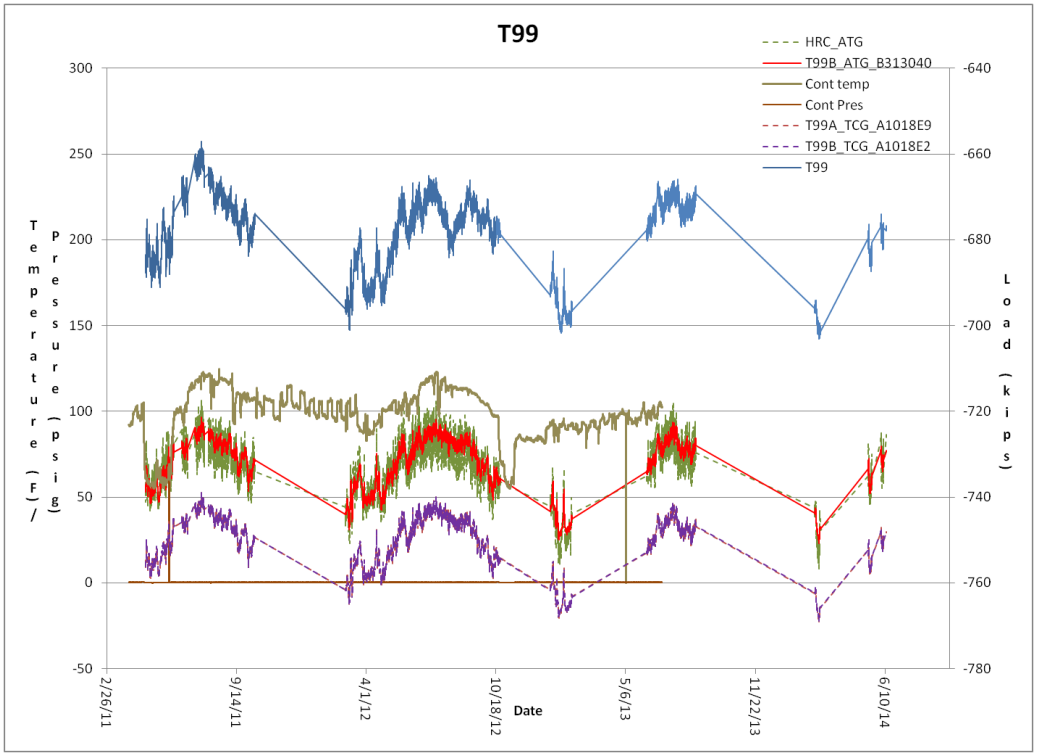


(a) Tendon load and temperature variation over three years

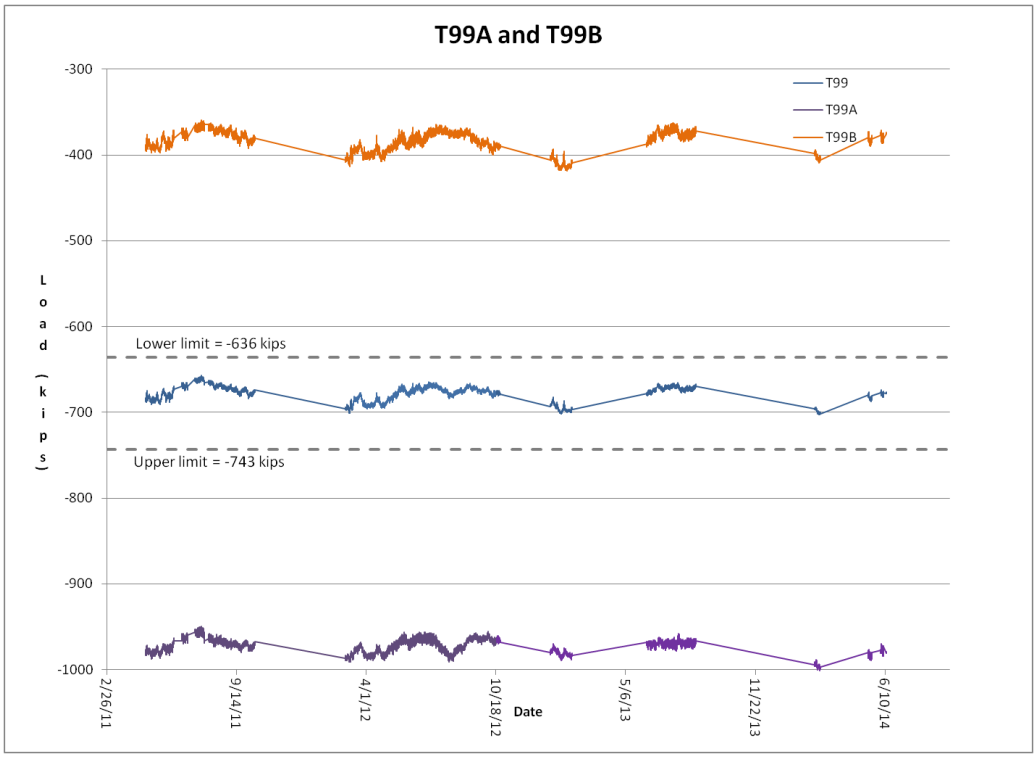


(b) Tendon shim loads and tendon load over three years

Figure 3-15: Tendon 91 Load and Temperature

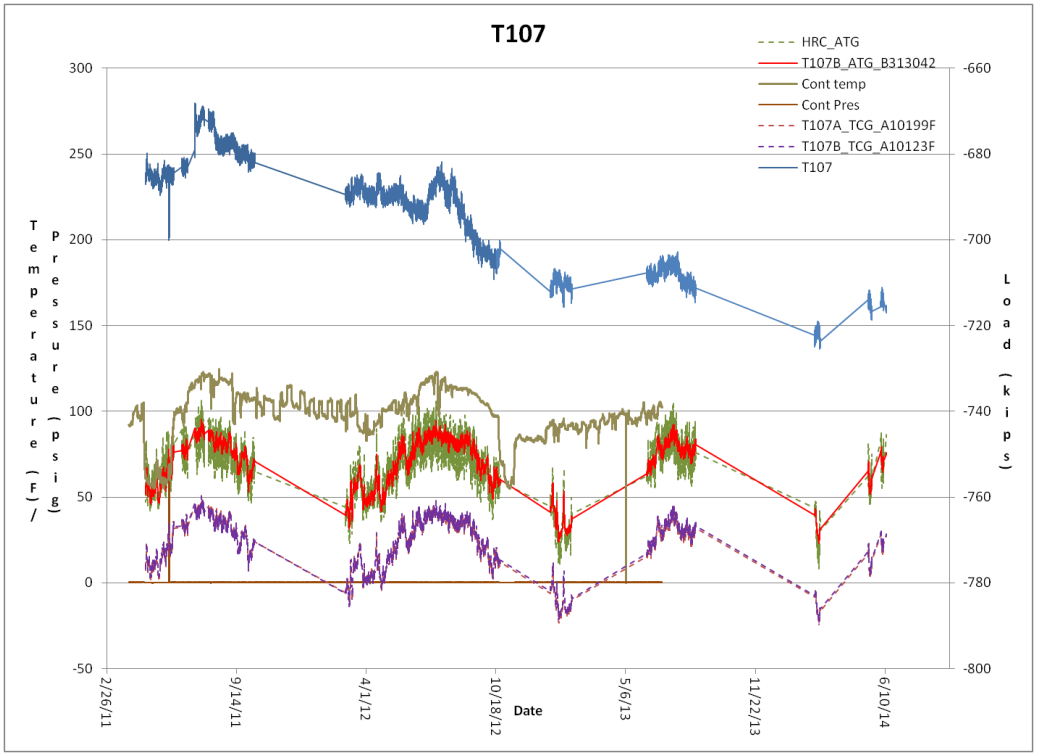


(a) Tendon load and temperature variation over three years

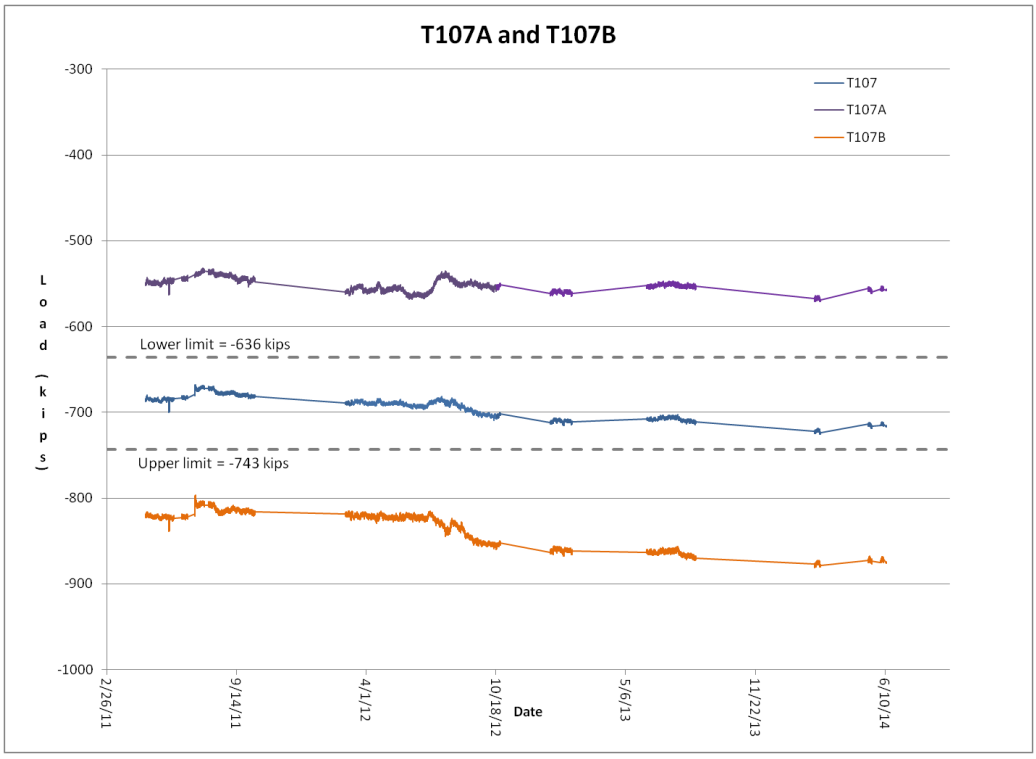


(b) Tendon shim loads and tendon load over three years

Figure 3-16: Tendon 99 Load and Temperature

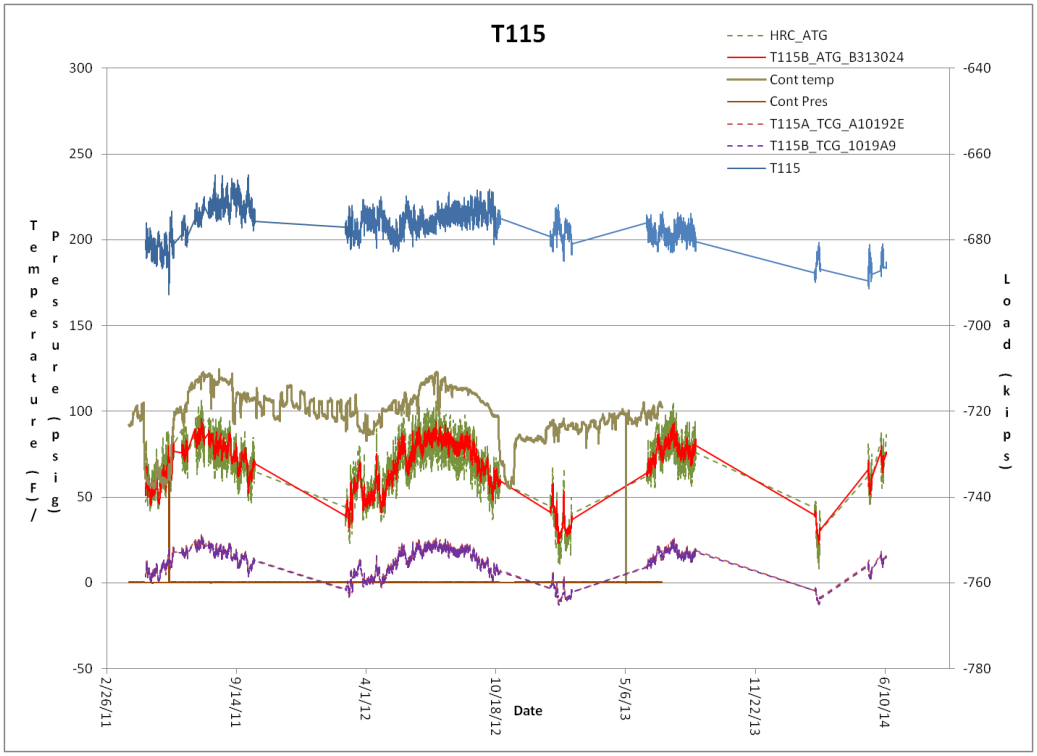


(a) Tendon load and temperature variation over three years

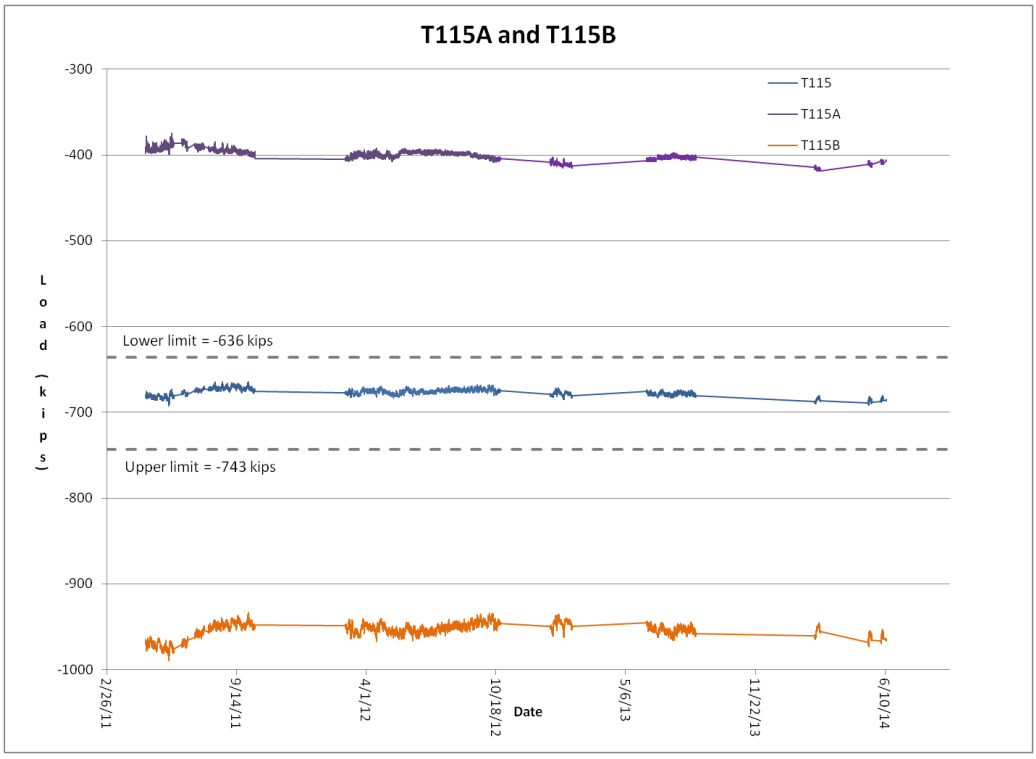


(b) Tendon shim loads and tendon load over three years

Figure 3-17: Tendon 107 Load and Temperature

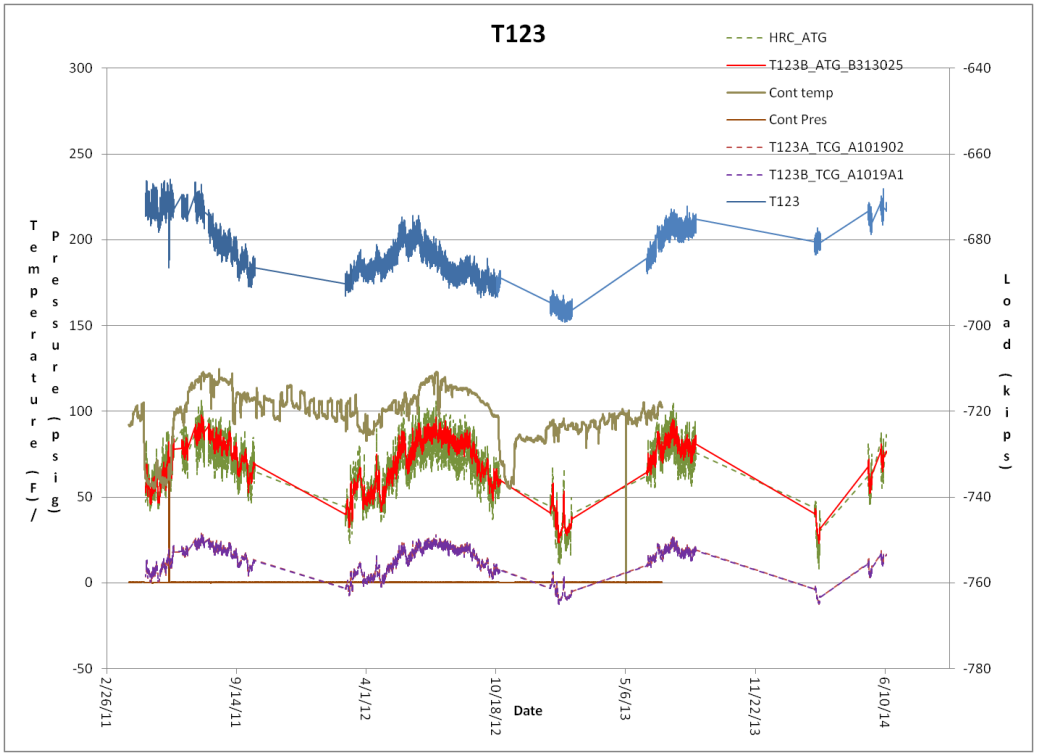


(a) Tendon load and temperature variation over three years

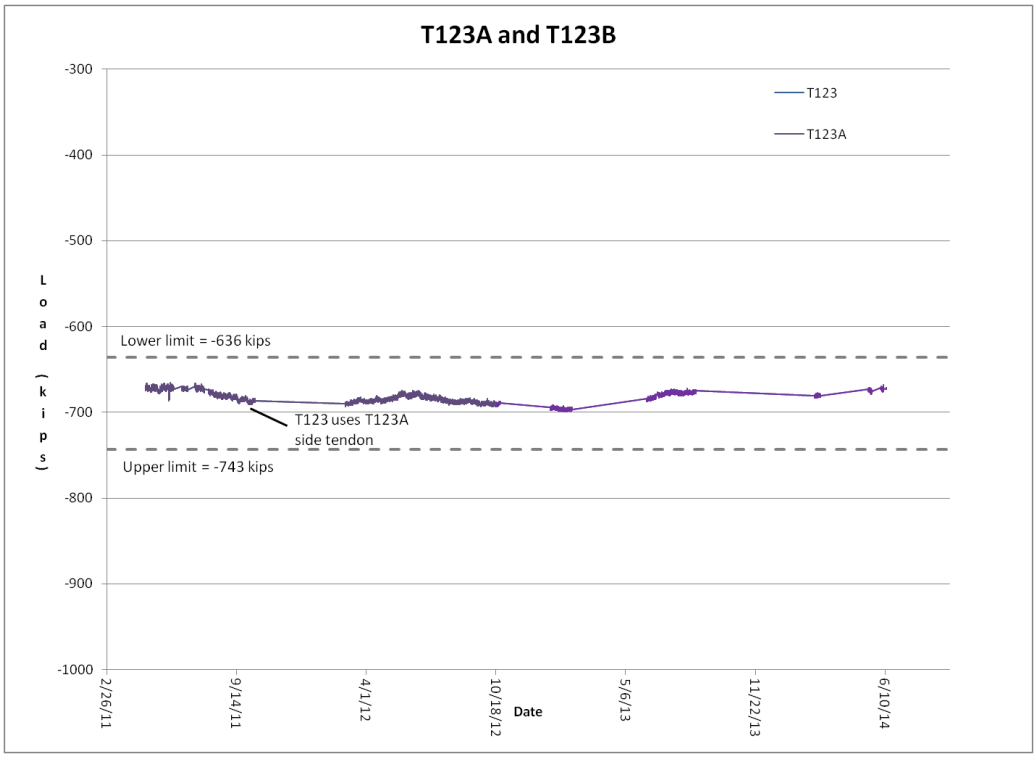


(b) Tendon shim loads and tendon load over three years

Figure 3-18: Tendon 115 Load and Temperature

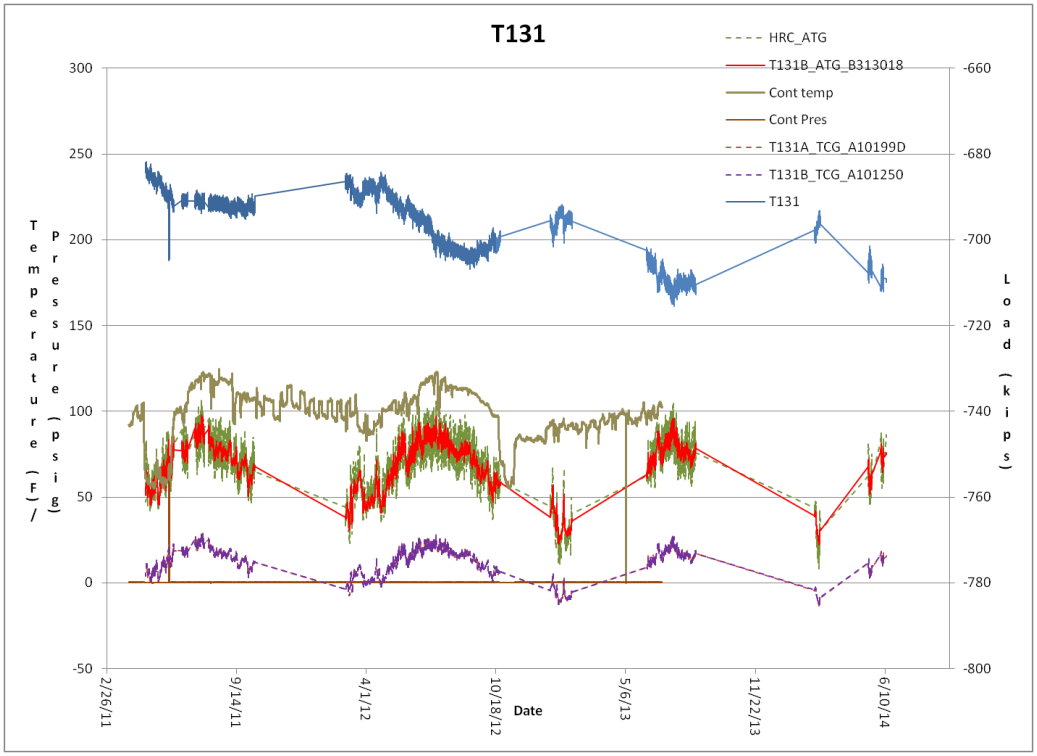


(a) Tendon load and temperature variation over three years

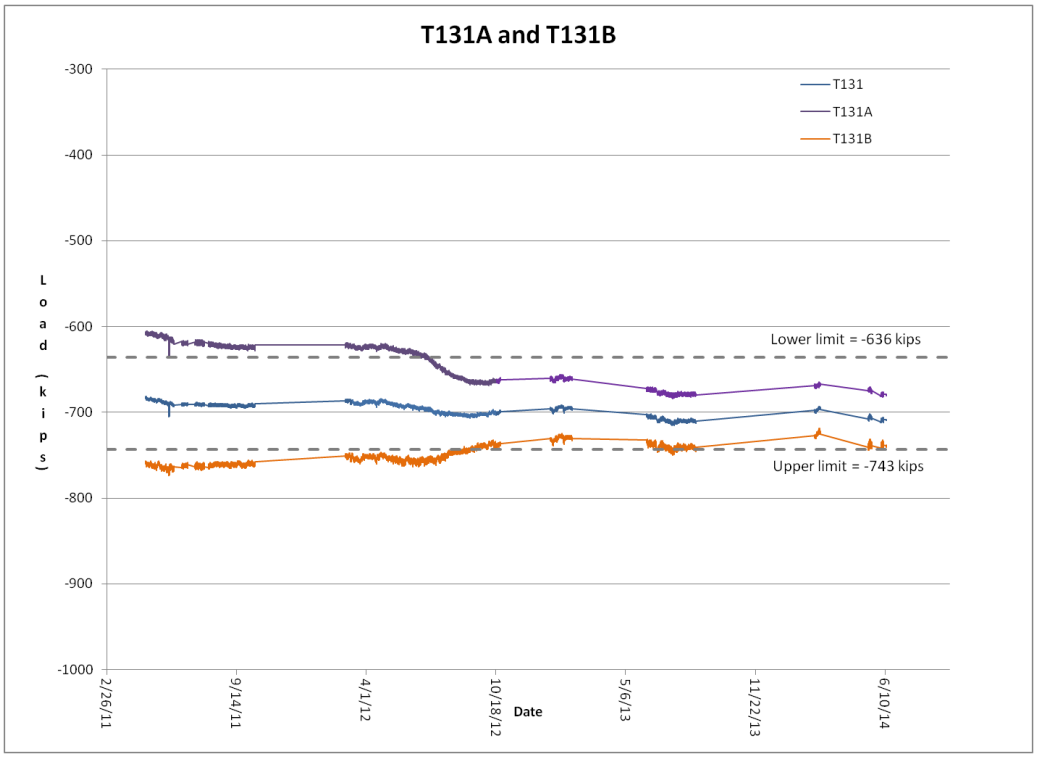


(b) Tendon shim loads and tendon load over three years

Figure 3-19: Tendon 123 Load and Temperature

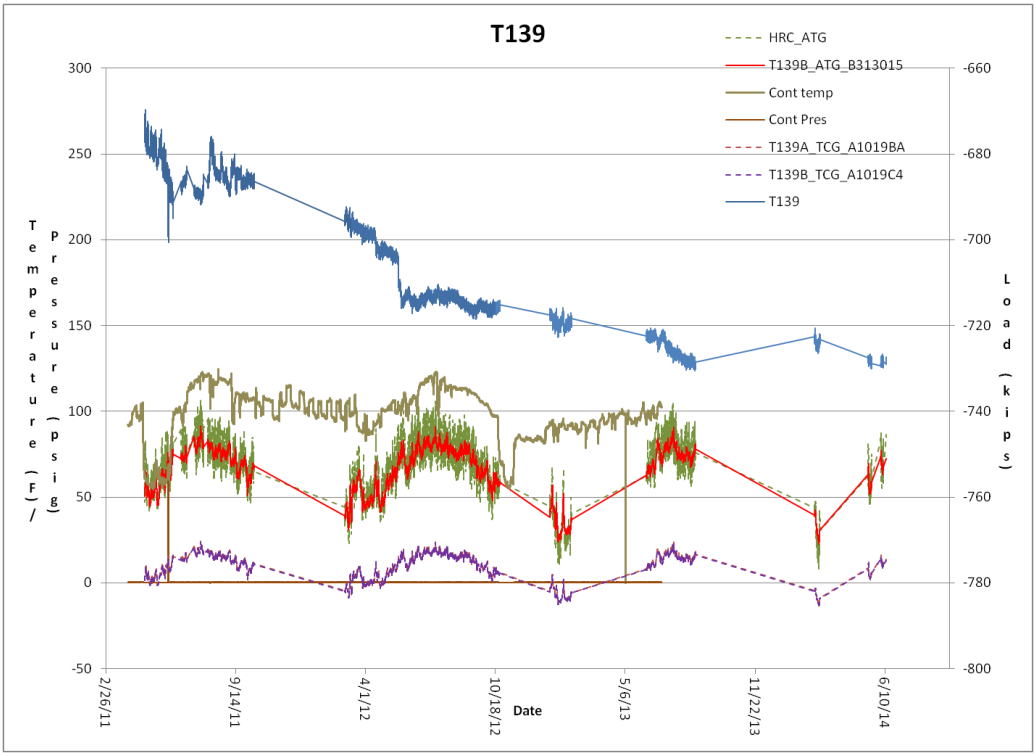


(a) Tendon load and temperature variation over three years

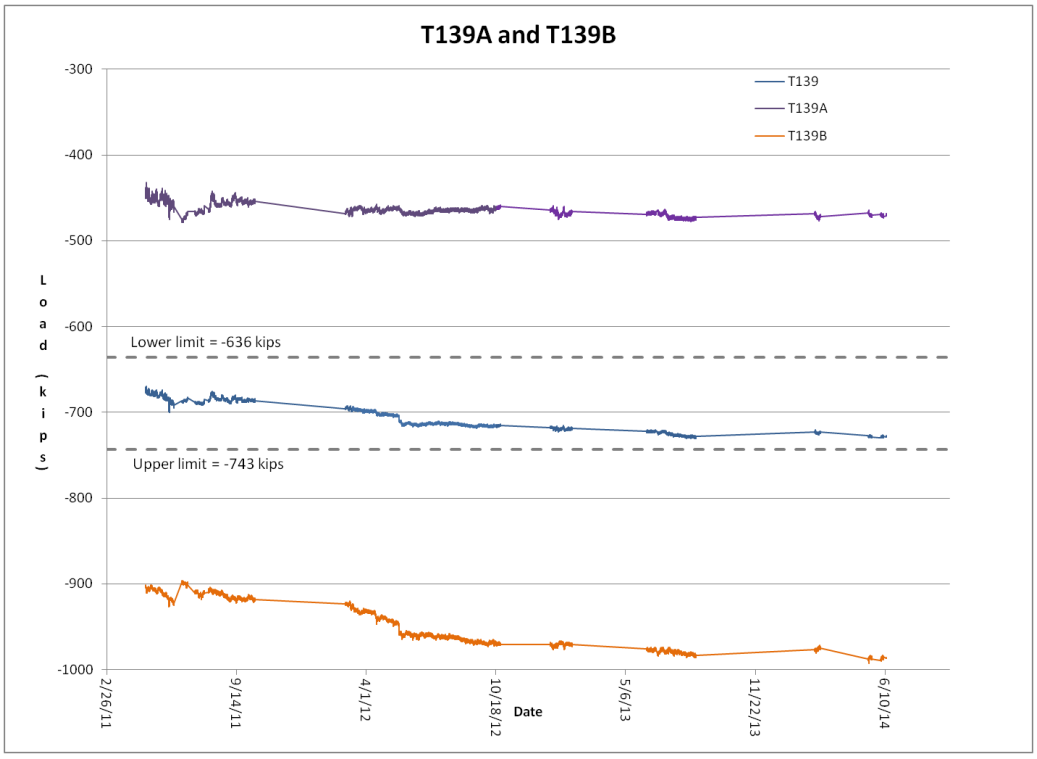


(b) Tendon shim loads and tendon load over three years

Figure 3-20: Tendon 131 Load and Temperature

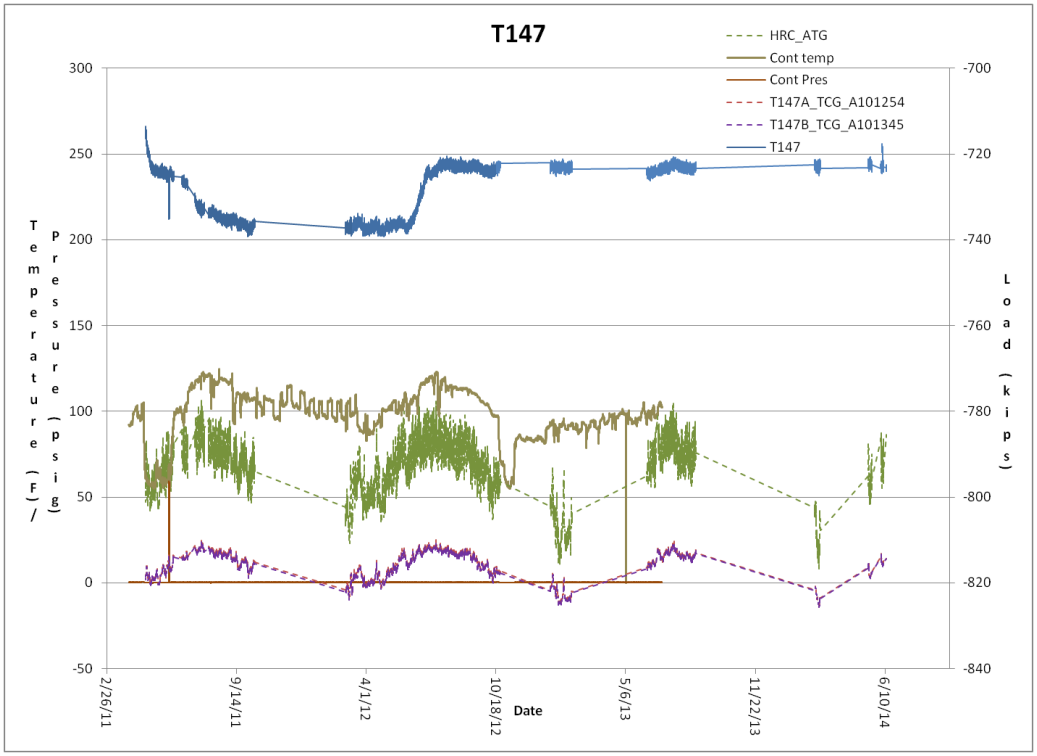


(a) Tendon load and temperature variation over three years

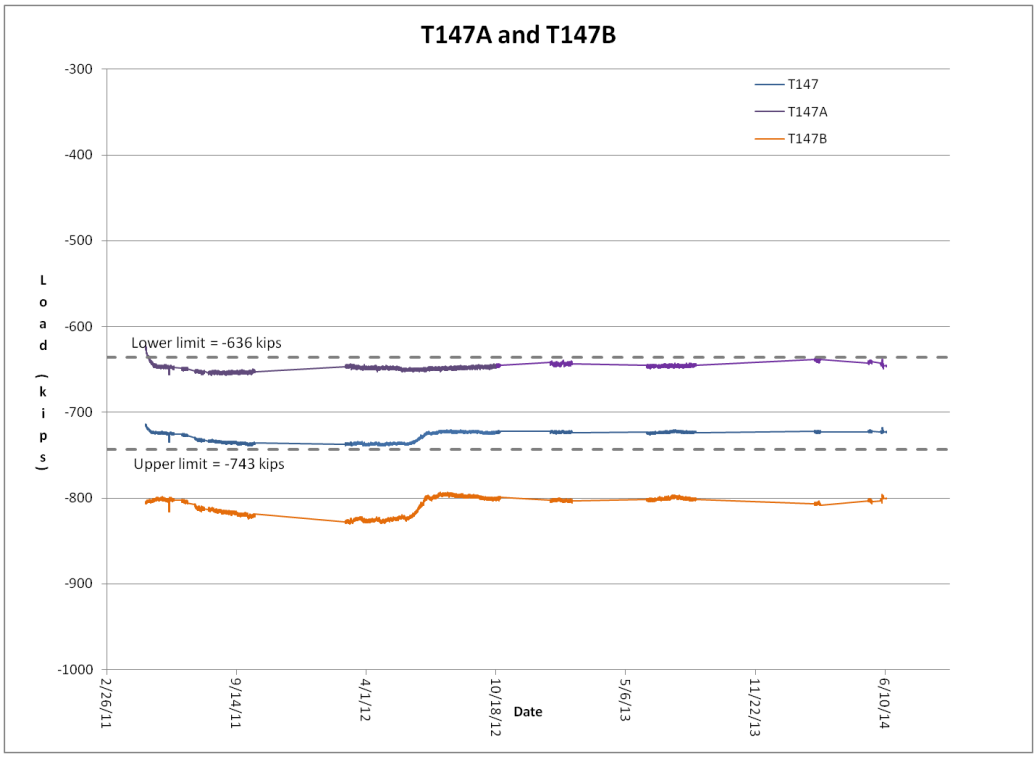


(b) Tendon shim loads and tendon load over three years

Figure 3-21: Tendon 139 Load and Temperature

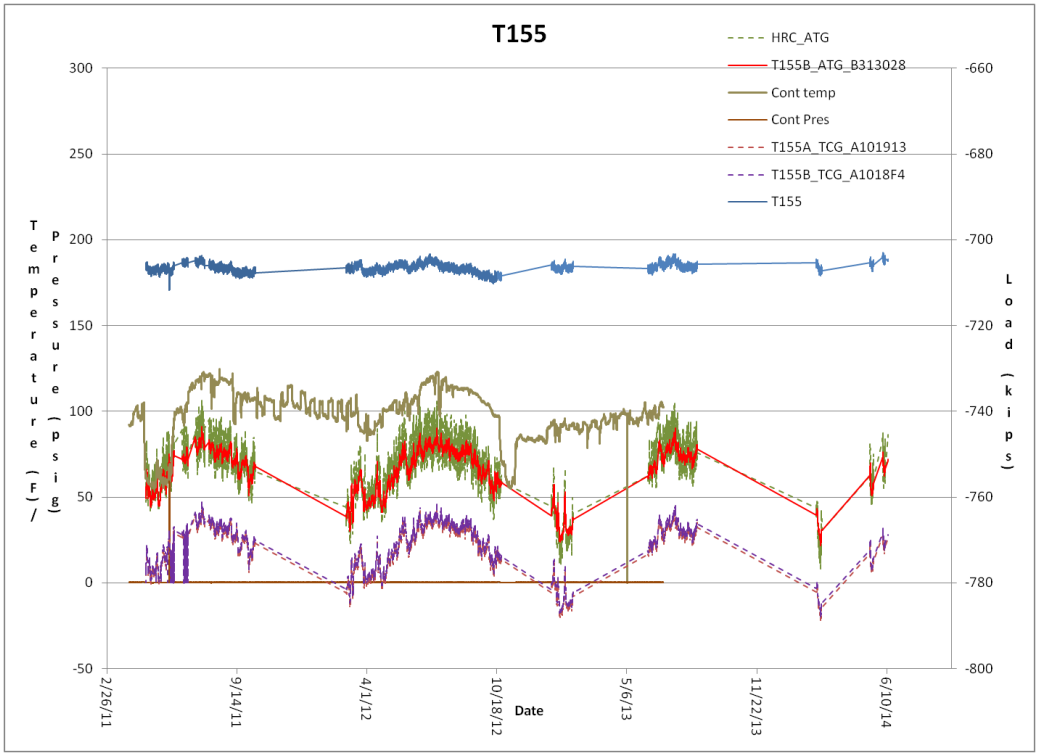


(a) Tendon load and temperature variation over three years

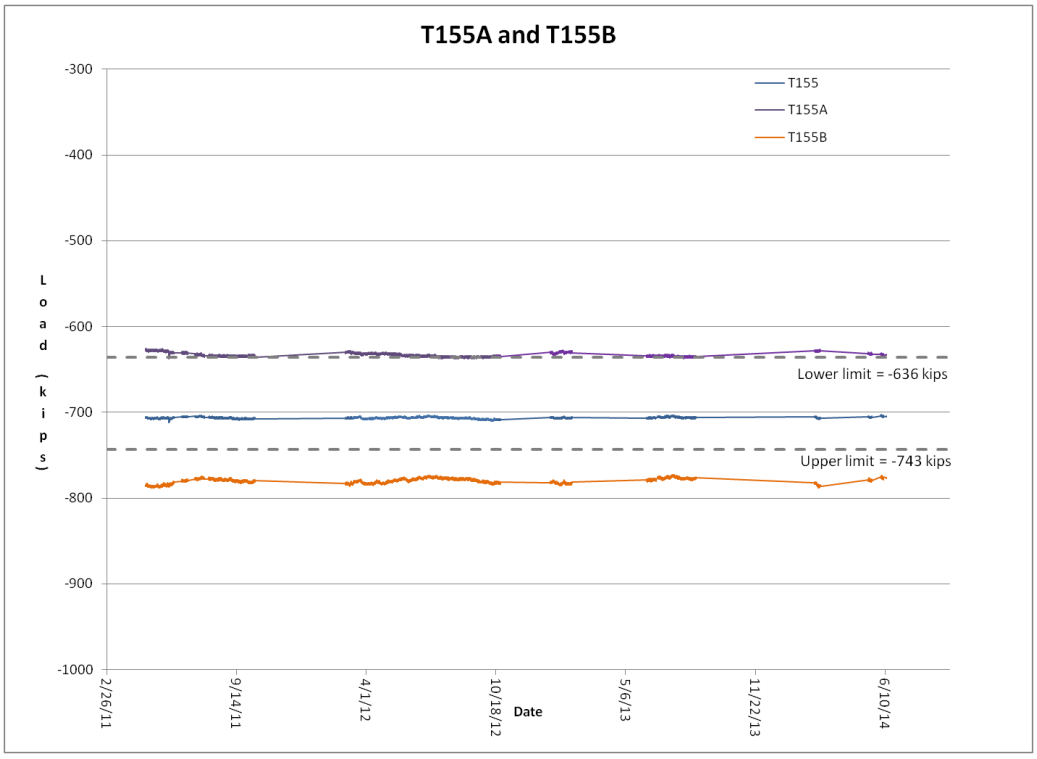


(b) Tendon shim loads and tendon load over three years

Figure 3-22: Tendon 147 Load and Temperature



(a) Tendon load and temperature variation over three years



(b) Tendon shim loads and tendon load over three years

Figure 3-23: Tendon 155 Load and Temperature

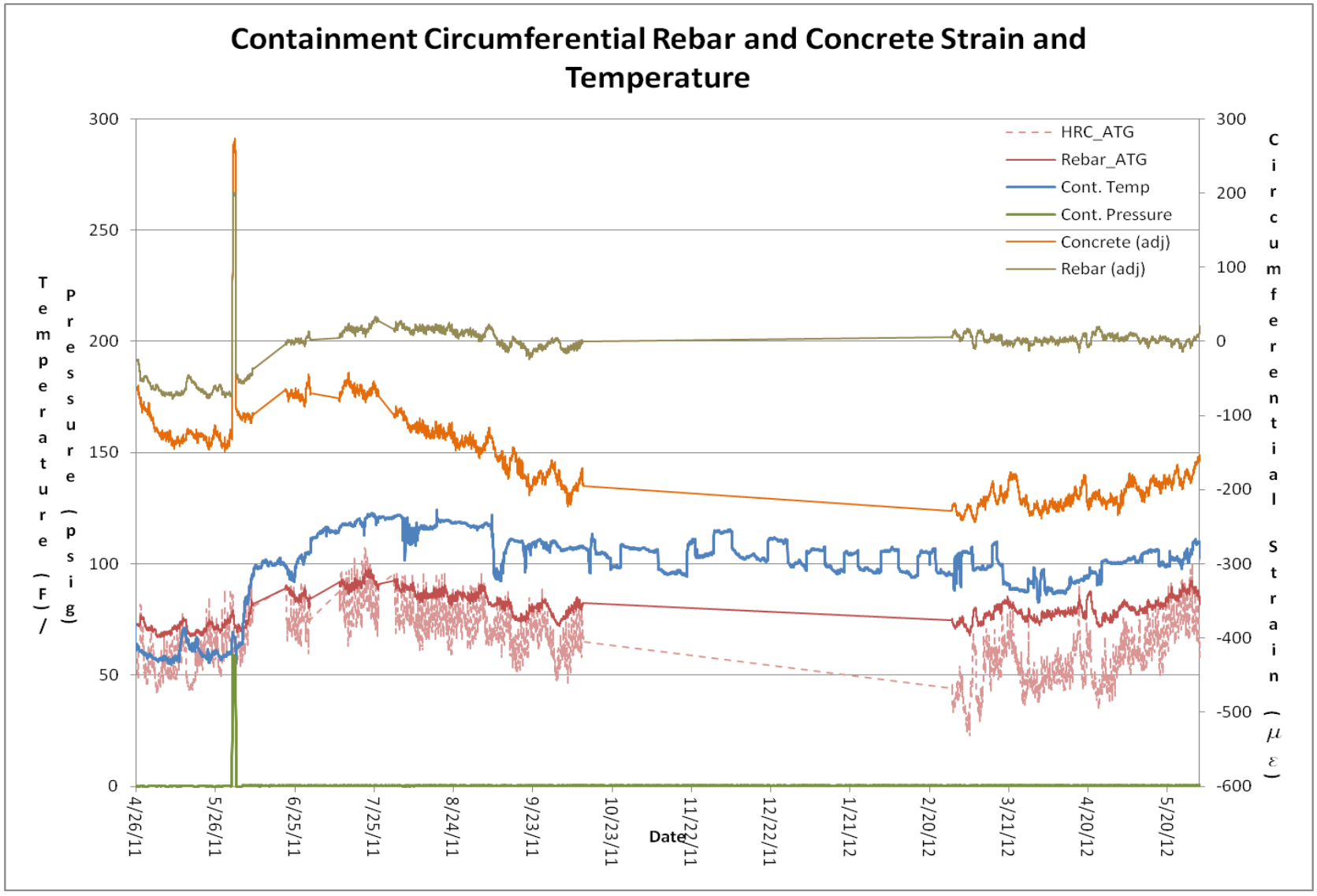


Figure 3-24a: Rebar and Concrete Data – 4/26/11 to 5/31/12

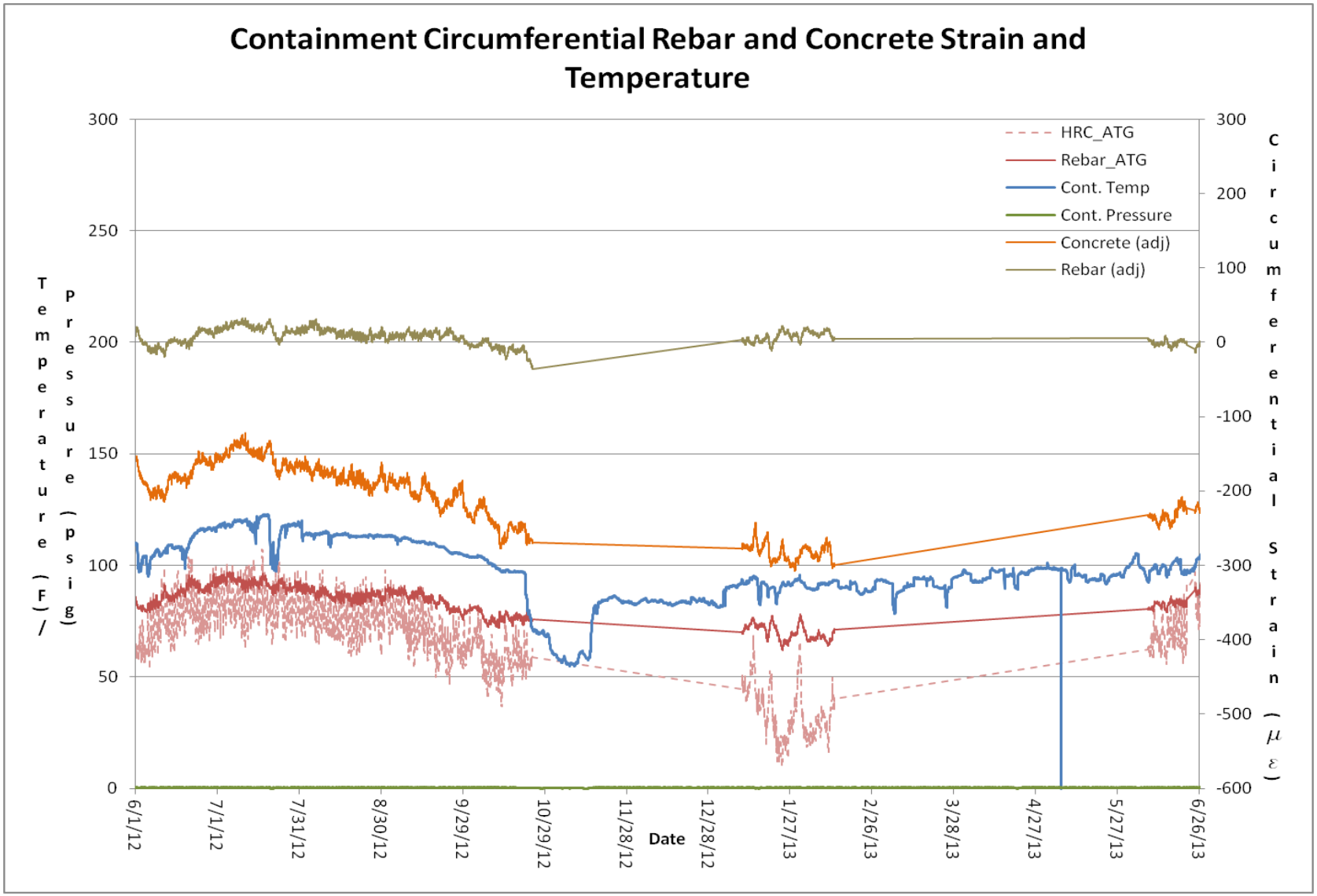


Figure 3-24b: Rebar and Concrete Data – 6/1/12 to 6/25/13

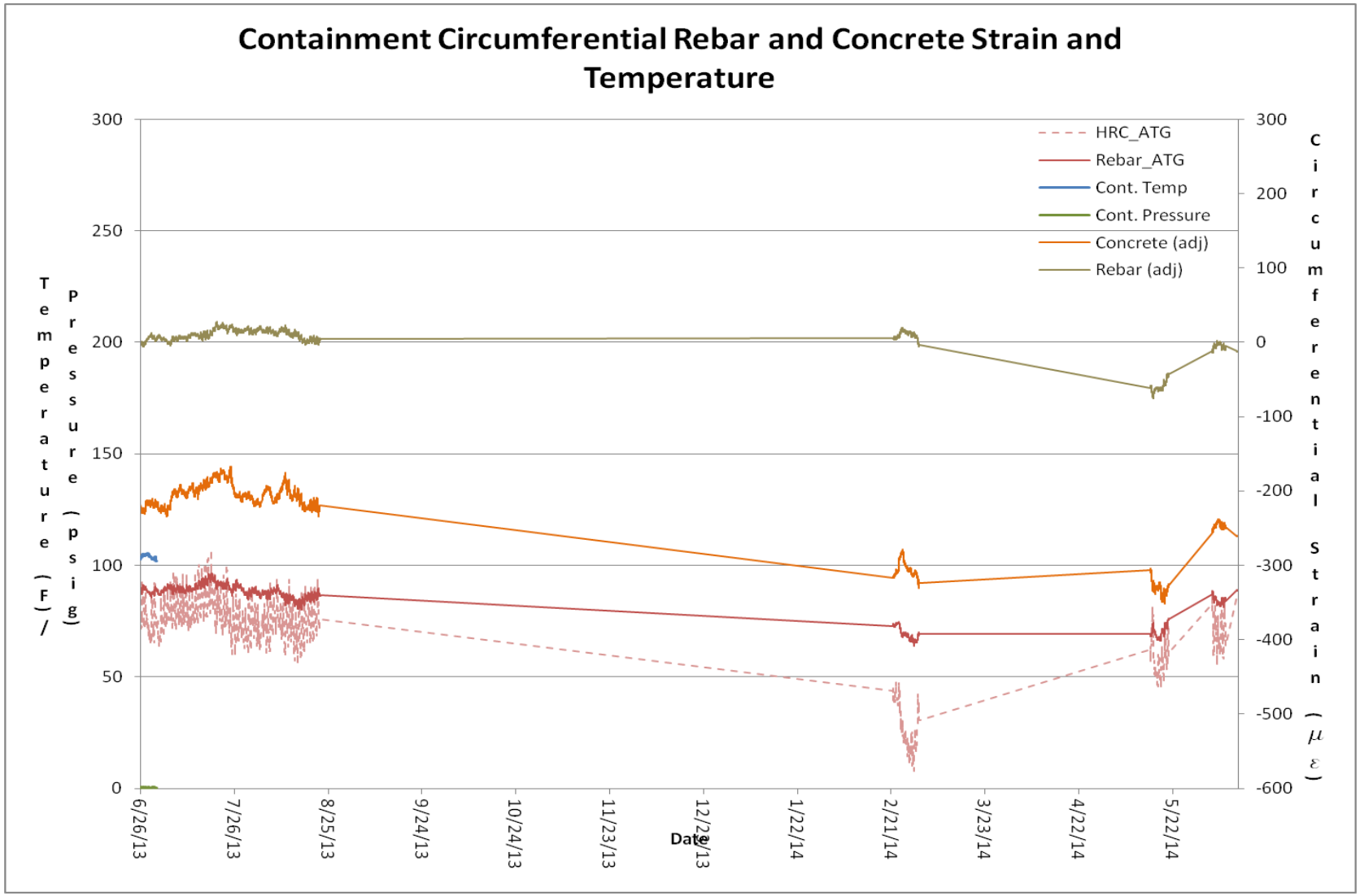


Figure 3-24c: Rebar and Concrete Data – 6/26/13 to 6/11/14

Attachment A:

Tendon Load and Temperature Data

Attachment A provides five plots for each tendon.

The first plot shows the average tendon load with containment temperature, ambient temperature, shim temperature, the A and B side temperature compensating gages (TCG), and containment pressure. This is the same plot as provided in the (a) plot of Figures 3-5 to 3-23.

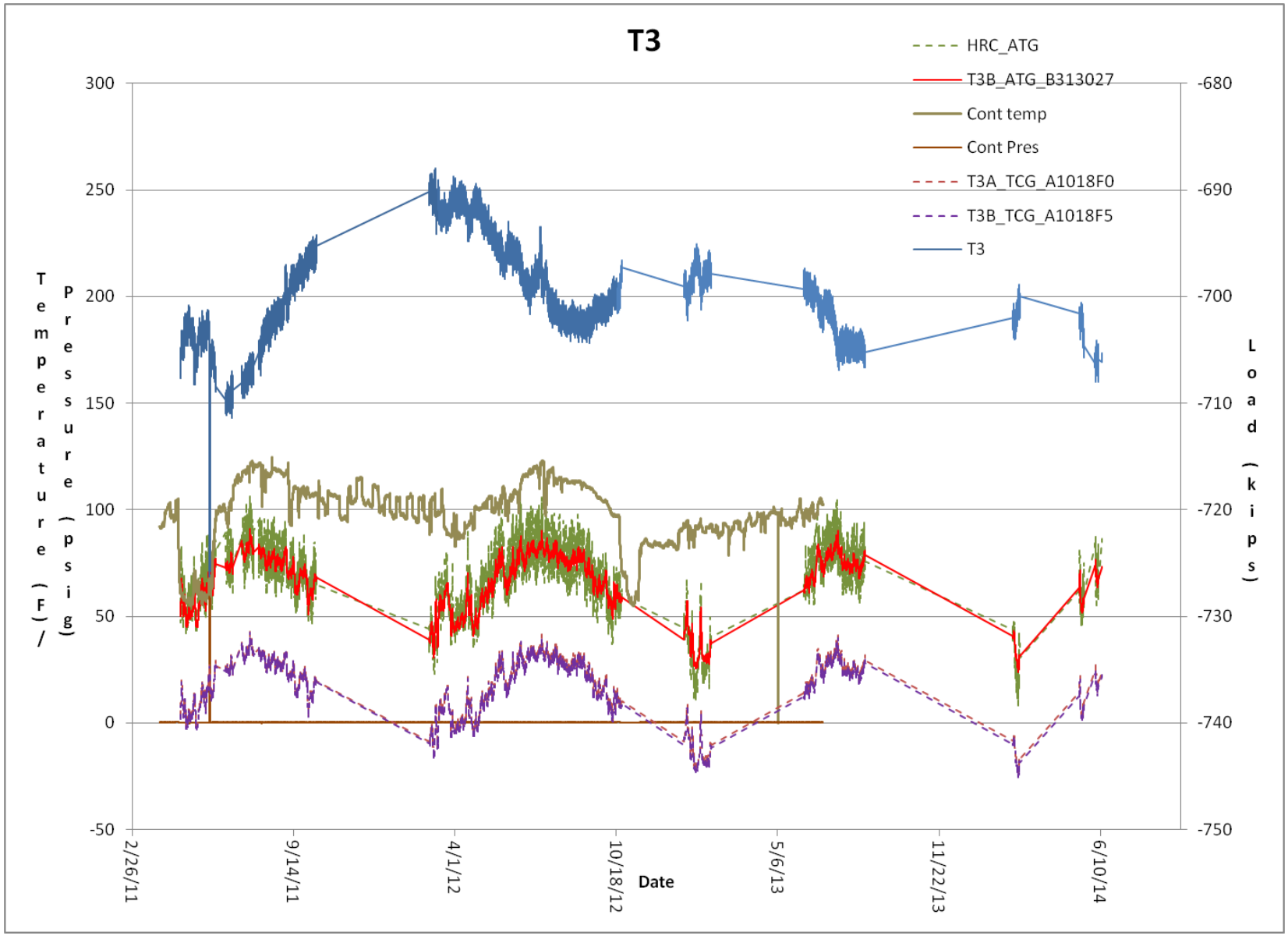
The second plot shows the A- and B-side shim loads with the average shim load. Also, the upper and lower limits are also plotted in this figure. This is the same plot as provided in the (b) plot of Figures 3-5 to 3-23.

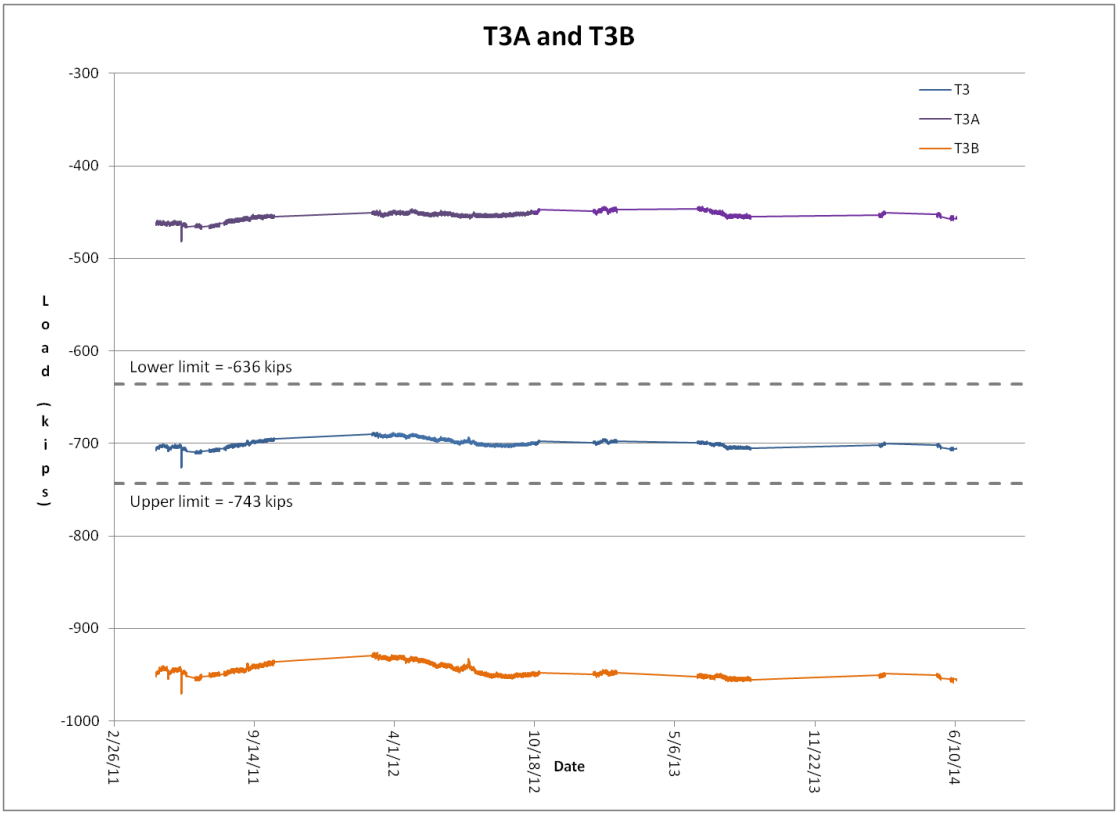
The third plot shows the normalized load on A-,and B-side shim load, and the average load. The normalization is performed based on the difference between the initial load and the rest of the data. This difference is then offset it to zero. The vertical axis shows the difference in load between the initial data and the rest of the data. The initial load is also shown in each figure.

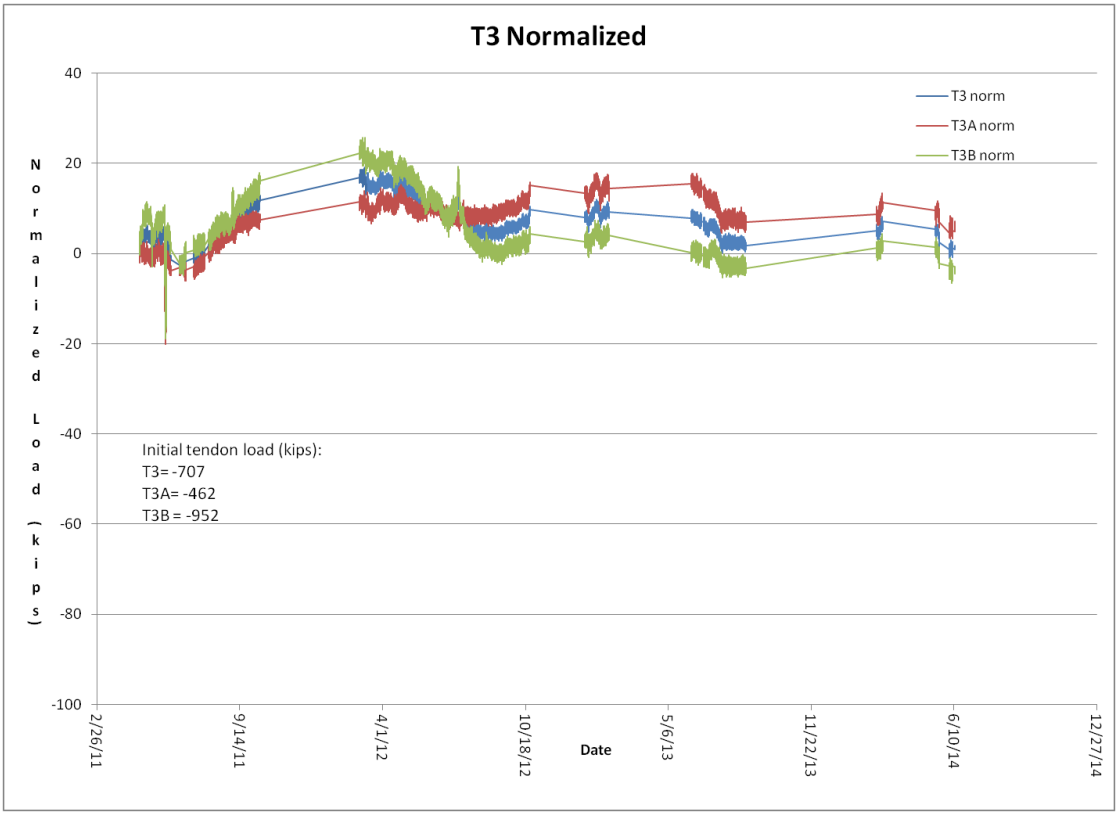
The fourth plot shows the relative temperature of the tendon. The A- and B-side TCG, which is the difference in the installation temperature and the current temperature, are plotted. In addition to this gage, the relative temperature between the absolute temperature and the installation temperature are also plotted.

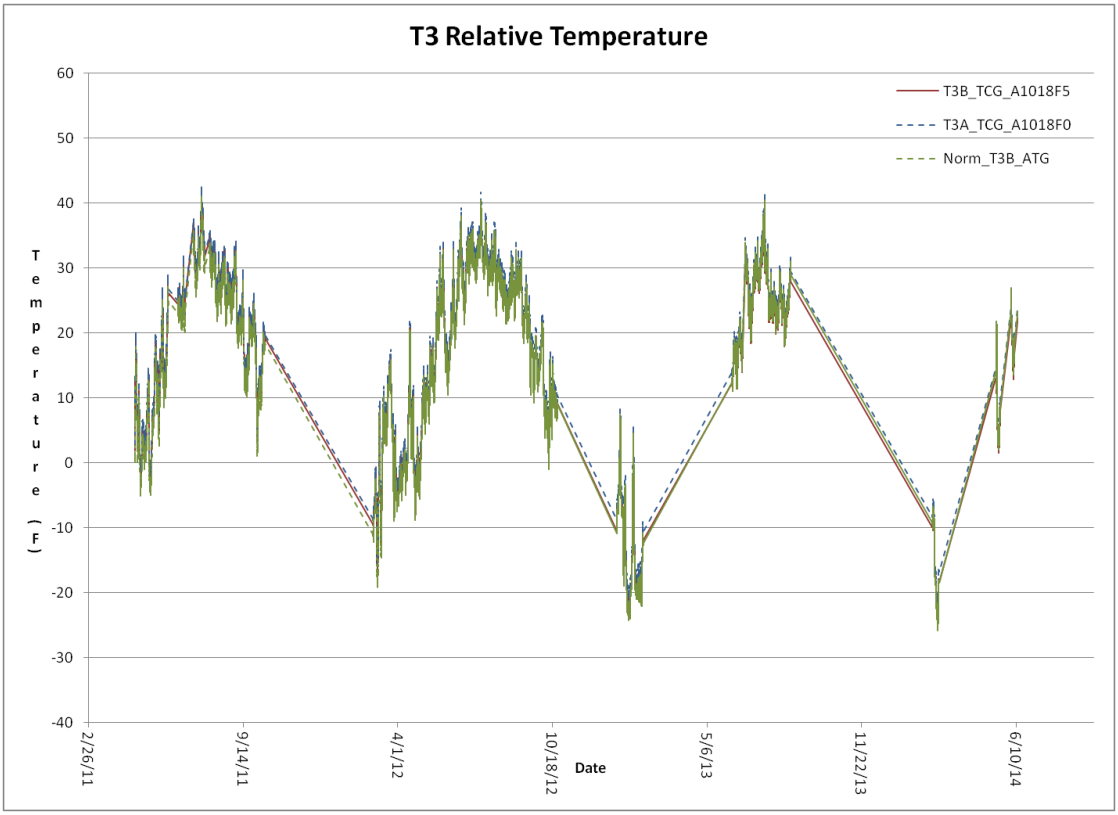
The fifth plot shows the absolute temperature gage for each tendon, the containment temperature, and the ambient temperature.

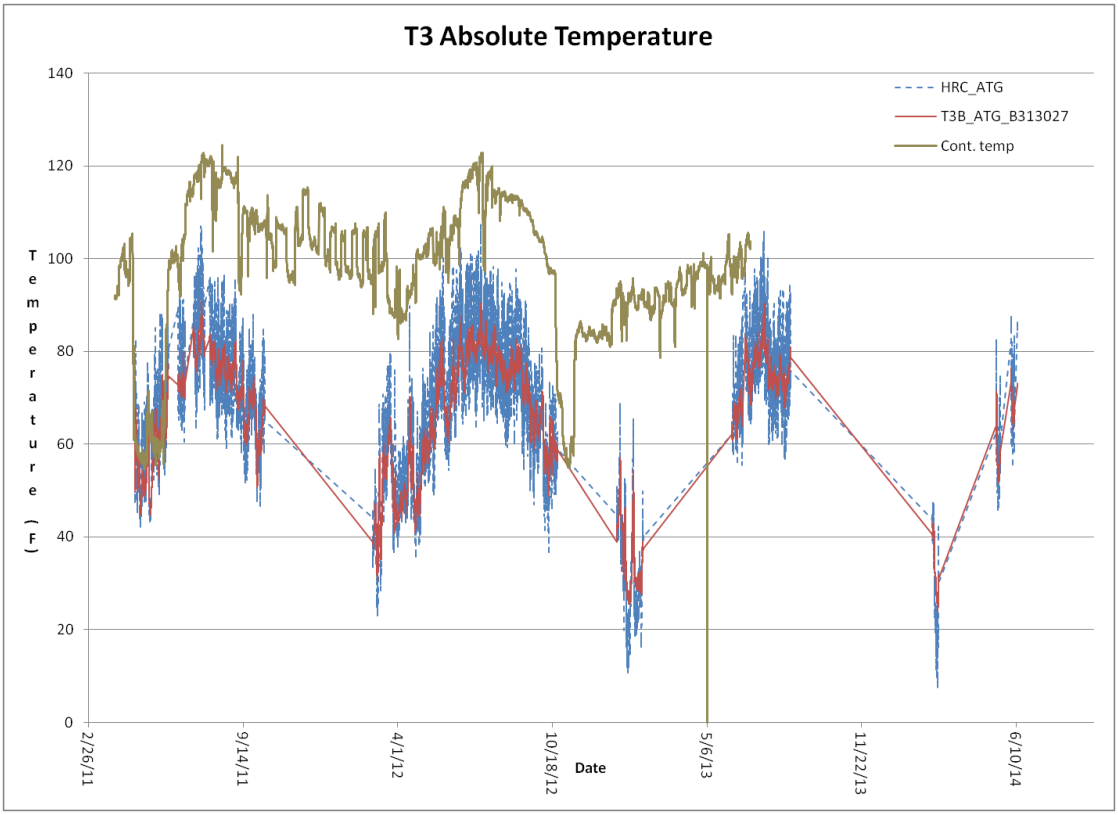
Tendon 3


T3
HRC_ATG
T3B_ATG_B313027
Cont temp
Cont Pres
T3A_TCG_A1018F0
T3B_TCG_A1018F5
T3
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-680
-690
-700
-710
-720
-730
-740
-750
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

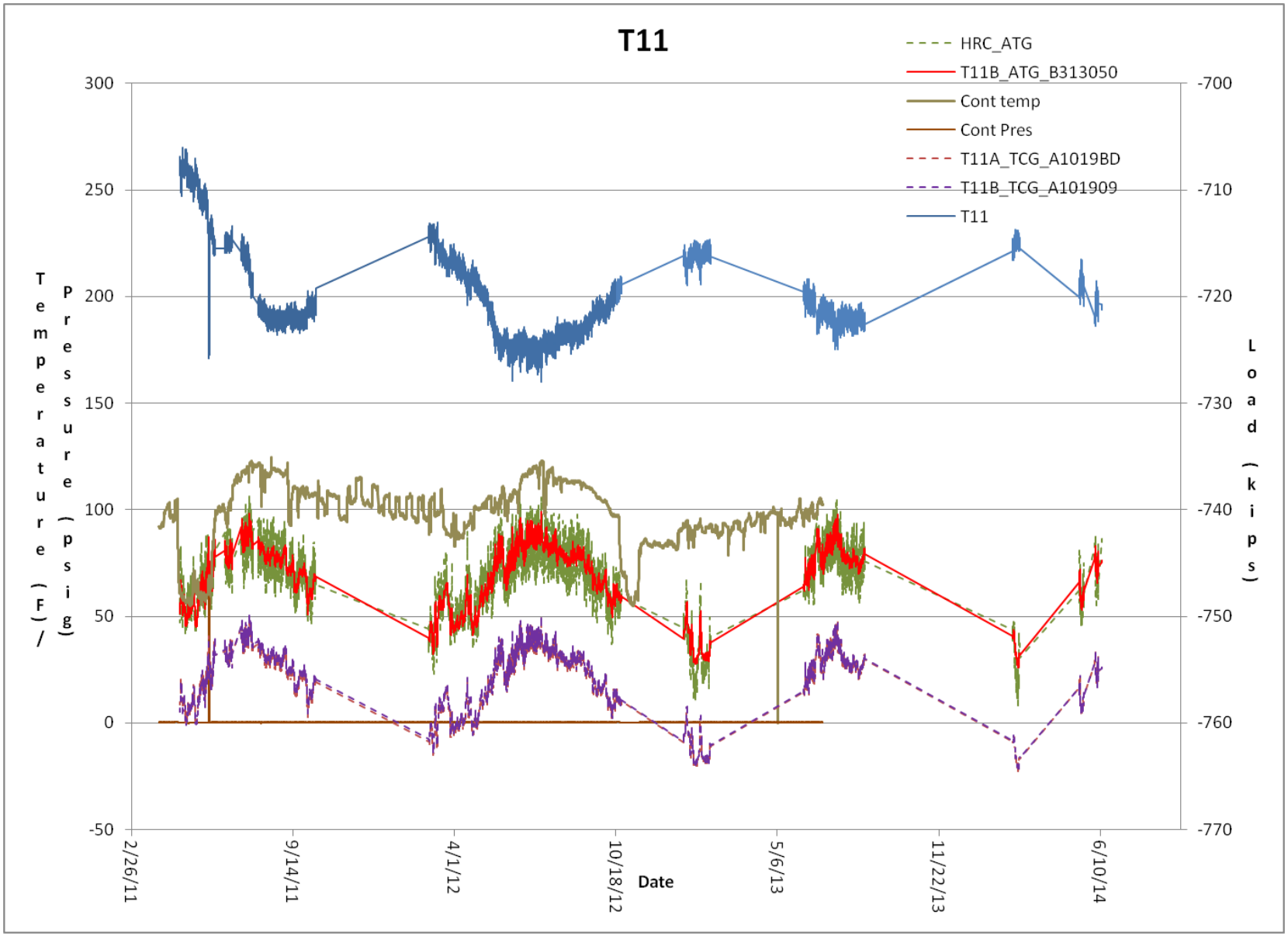

T3A and T3B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T3
T3A
T3B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

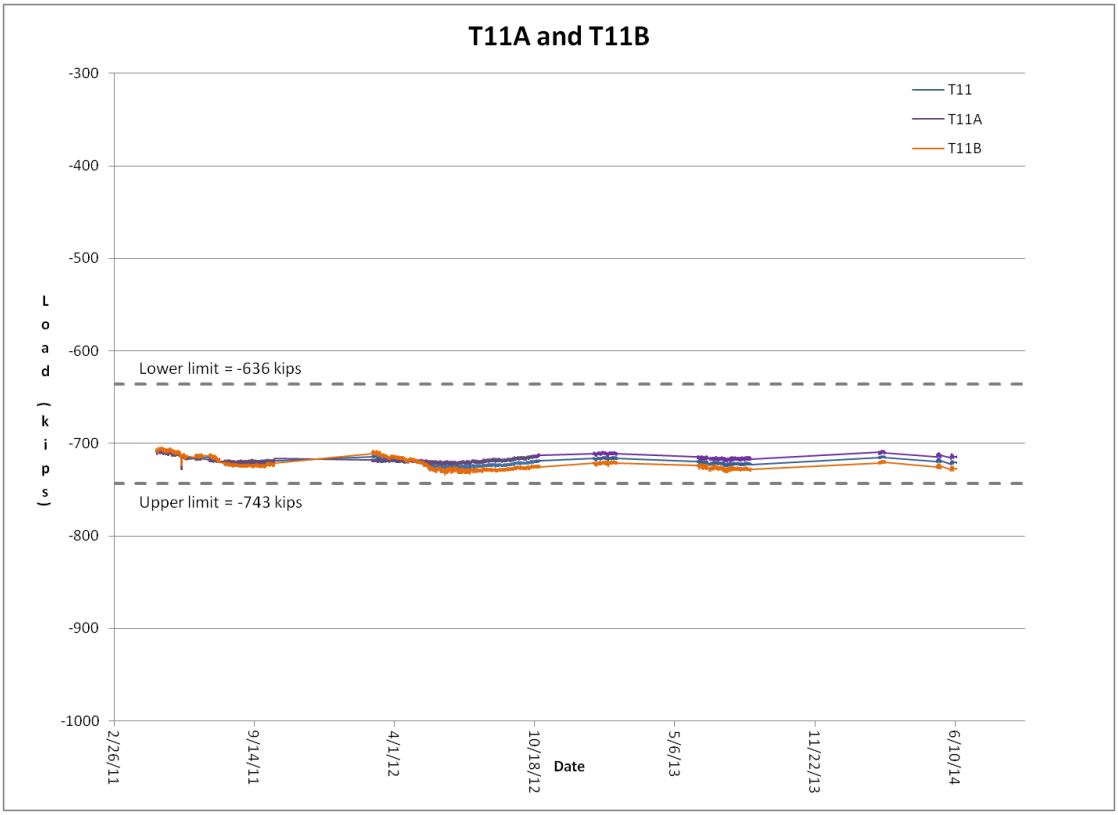

T3 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T3 norm
T3A norm
T3B norm
Initial tendon load (kips):
T3= -707
T3A= -462
T3B = -952
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

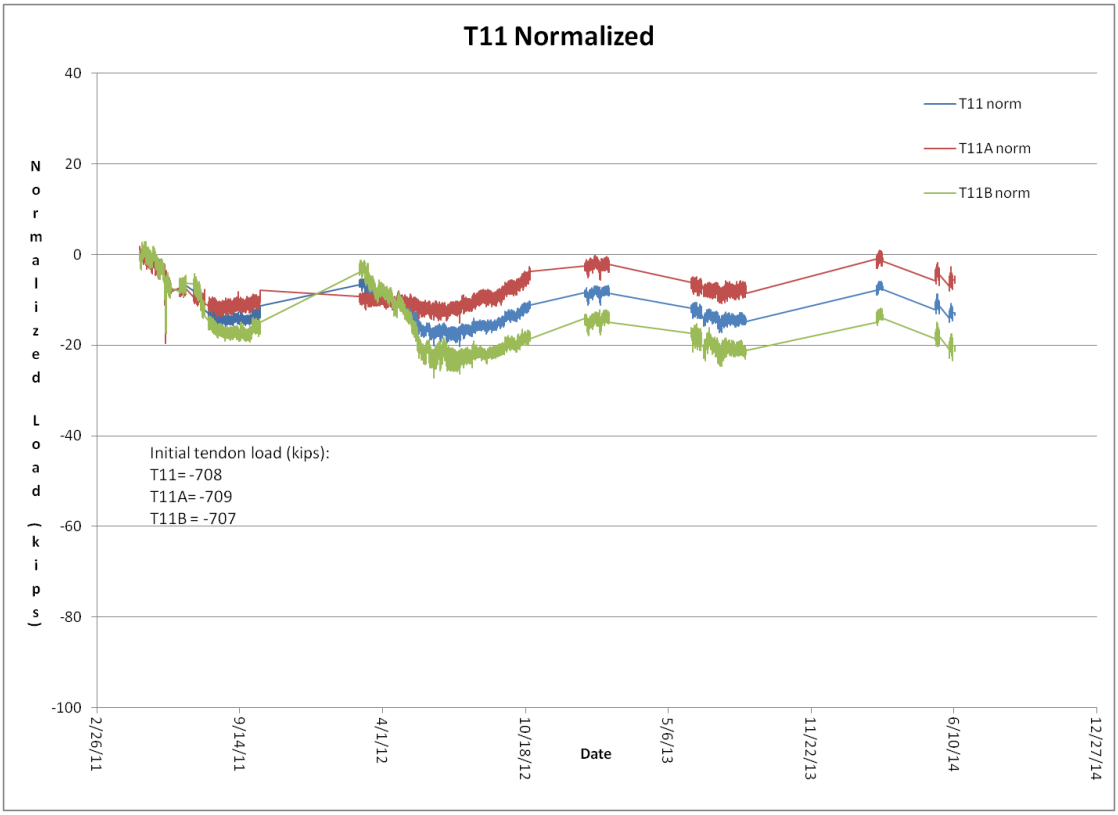

T3 Relative Temperature
T3B_TCG_A1018F5
T3A_TCG_A1018F0
Norm_T3B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

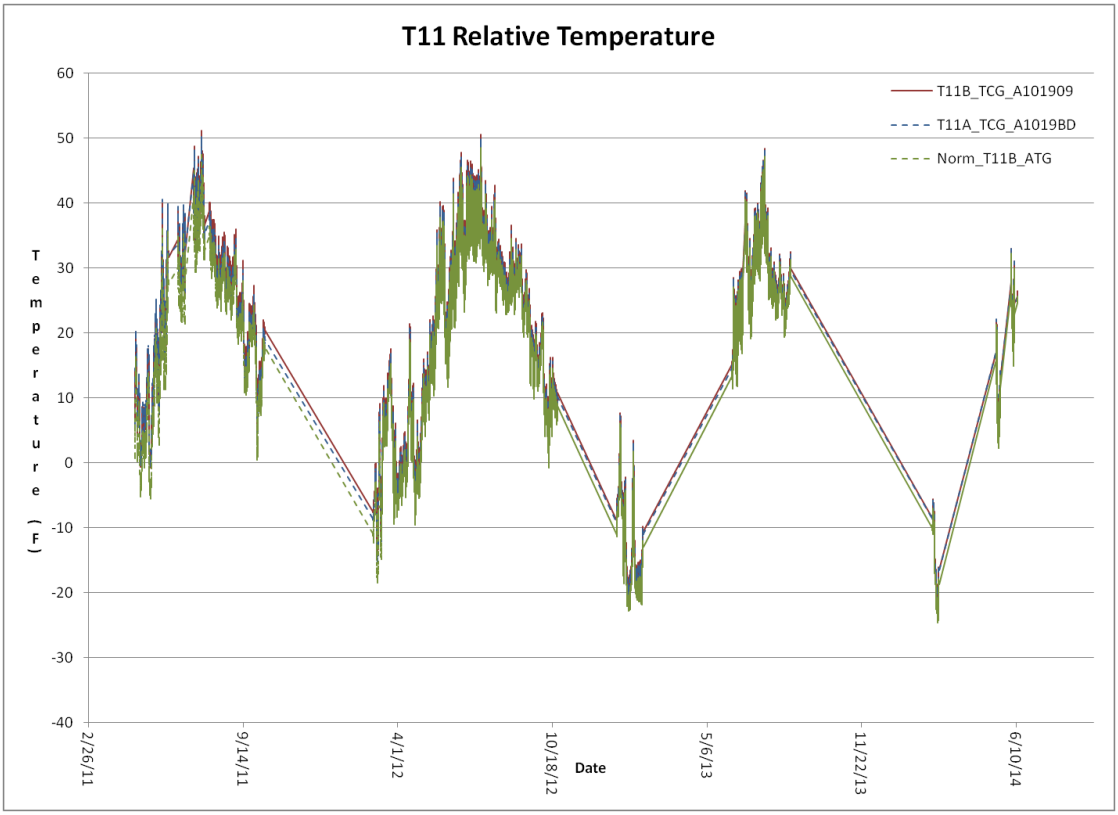

T3 Absolute Temperature
HRC_ATG
T3B_ATG_B313027
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

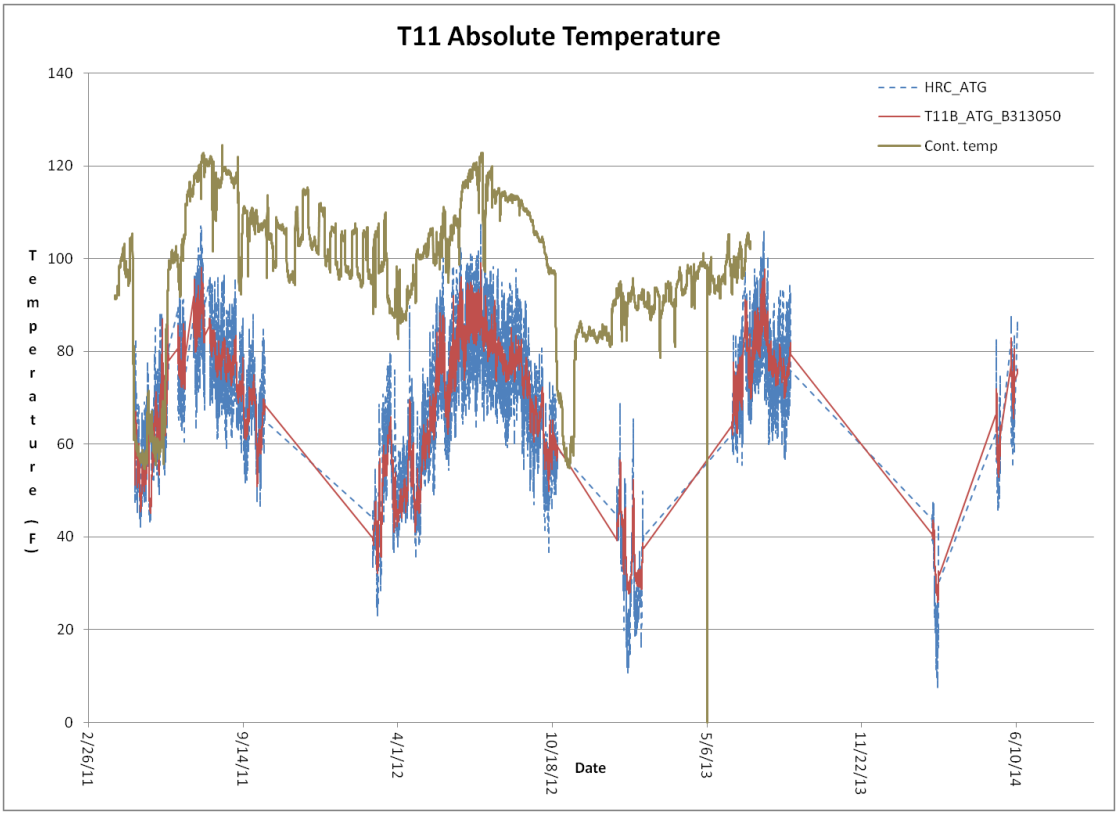
Tendon 11


T11
HRC_ATG
T11B_ATG_B313050
Cont temp
Cont Pres
T11A_TCG_A1019BD
T11B_TCG_A101909
T11
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-700
-710
-720
-730
-740
-750
-760
-770
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

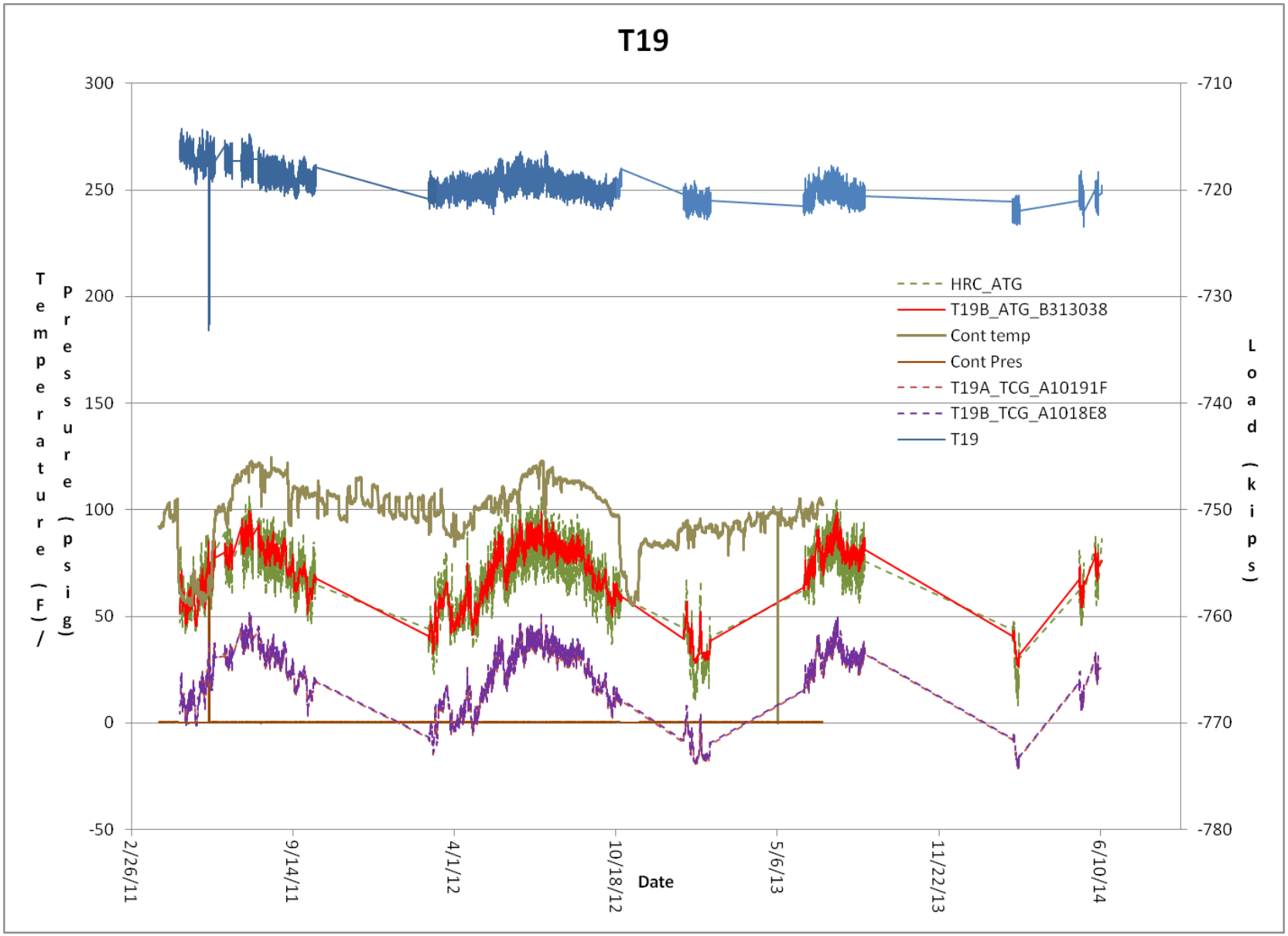

T11A and T11B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T11
T11A
T11B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

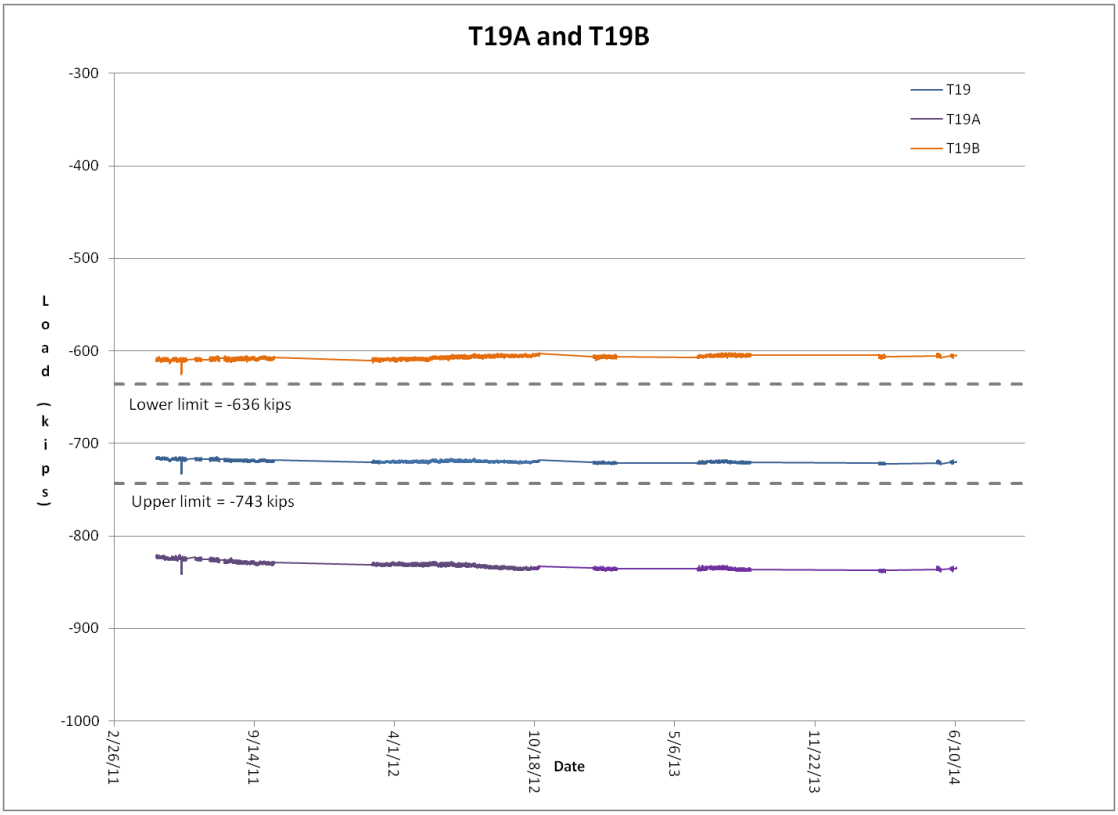

T11 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T11 norm
T11A norm
T11B norm
Initial tendon load (kips):
T11= -708
T11A= -709
T11B = -707
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

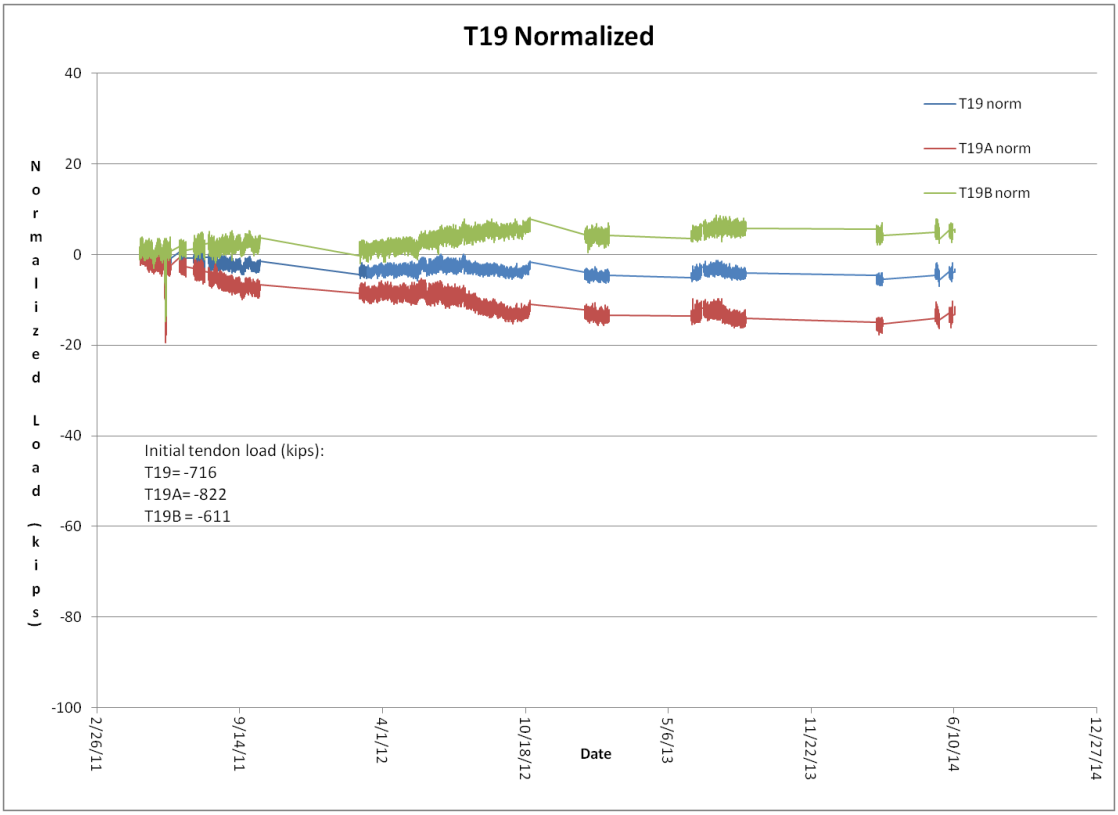

T11 Relative Temperature
T11B_TCG_A101909
T11A_TCG_A1019BD
Norm_T11B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

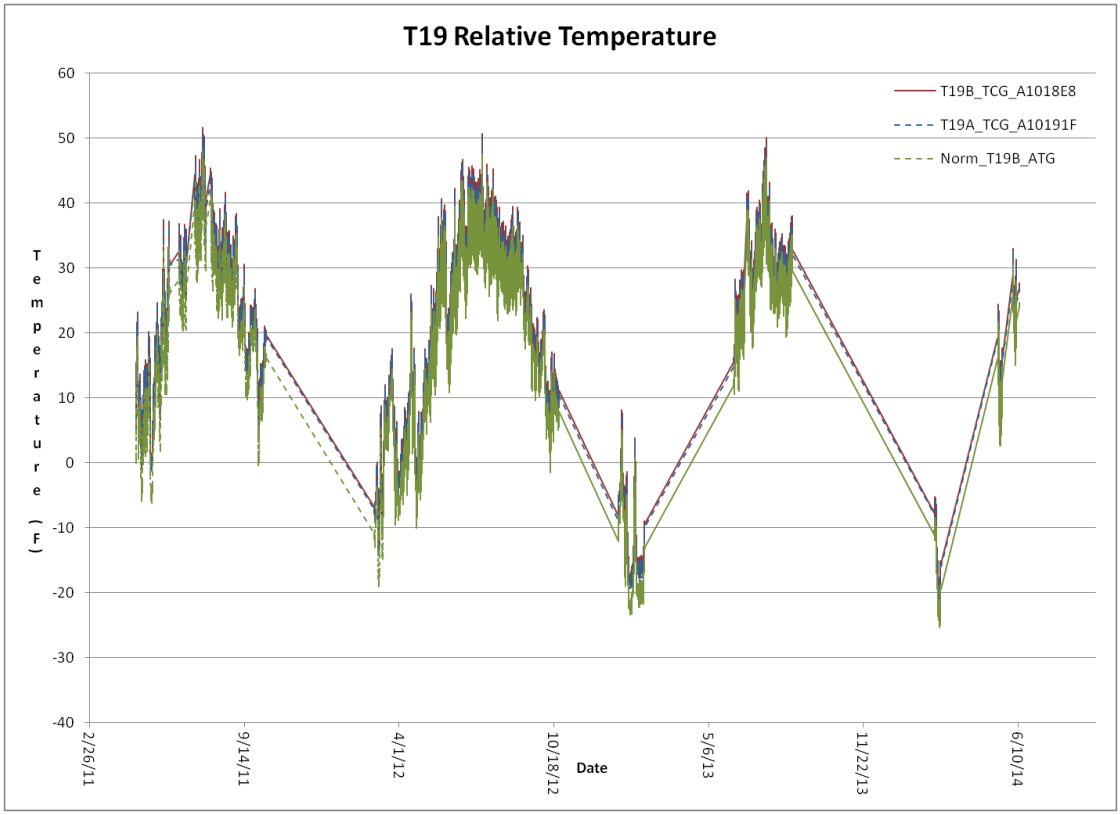

T11 Absolute Temperature
HRC_ATG
T11B_ATG_B313050
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

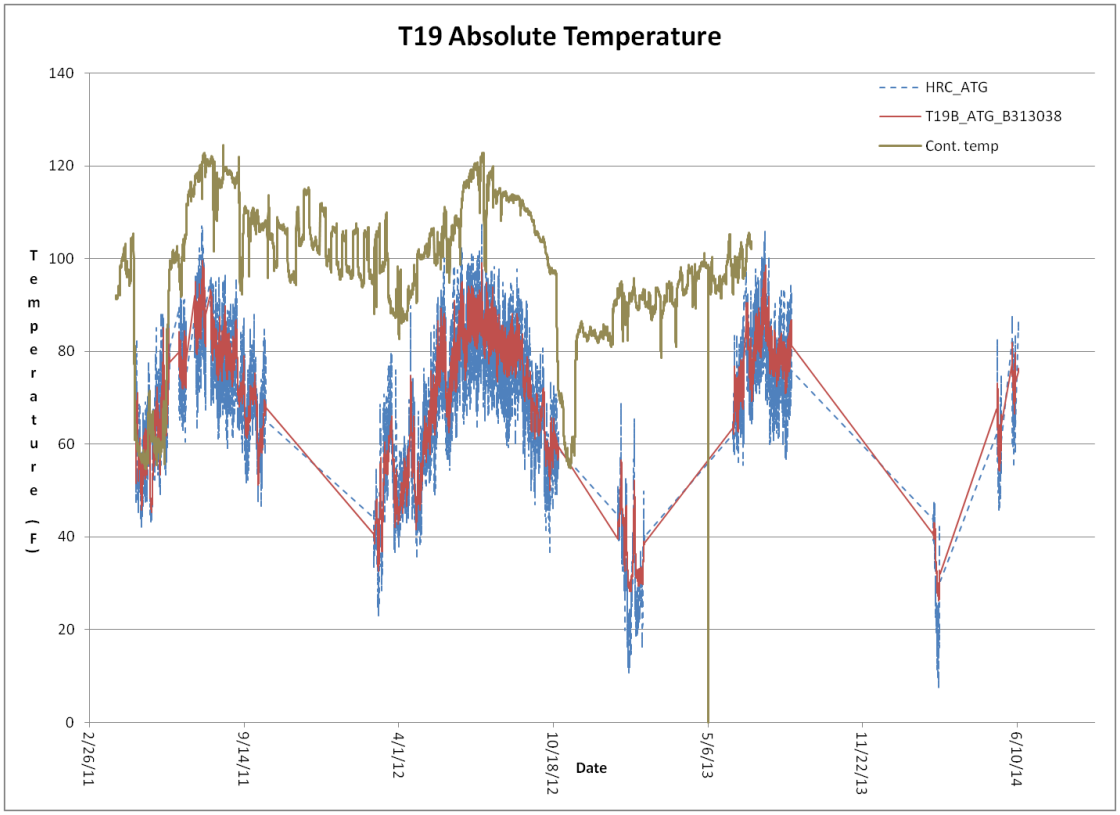
Tendon 19


T19
300
250
200
150
100
50
0
-50
-710
-720
-730
-740
-750
-760
-770
-780
Temperature (F) / Pressure (psig)
Load (kips)
HRC_ATG
T19B_ATG_B313038
Cont temp
Cont Pres
T19A_TCG_A10191F
T19B_TCG_A1018E8
T19
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

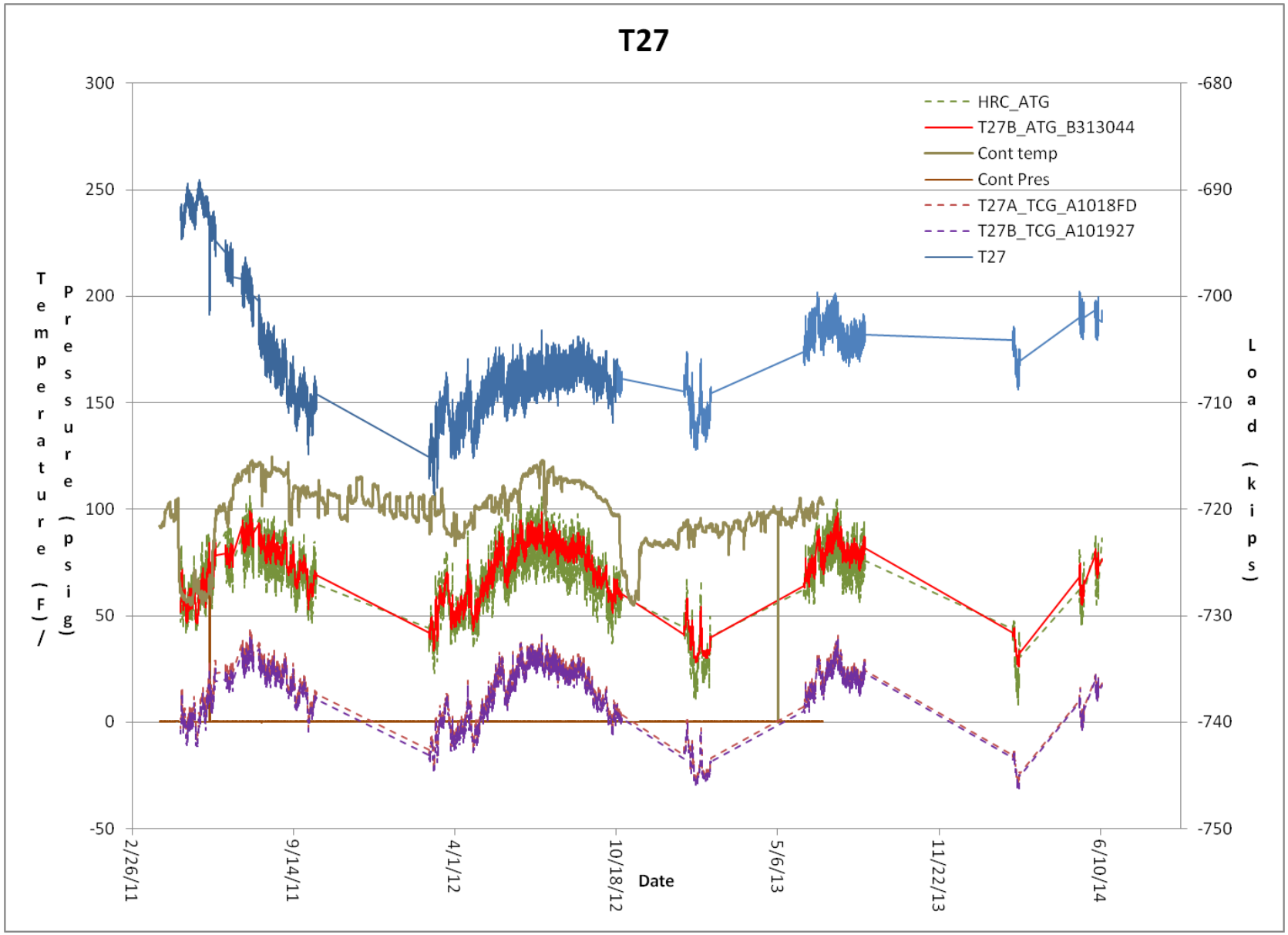

T19A and T19B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T19
T19A
T19B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

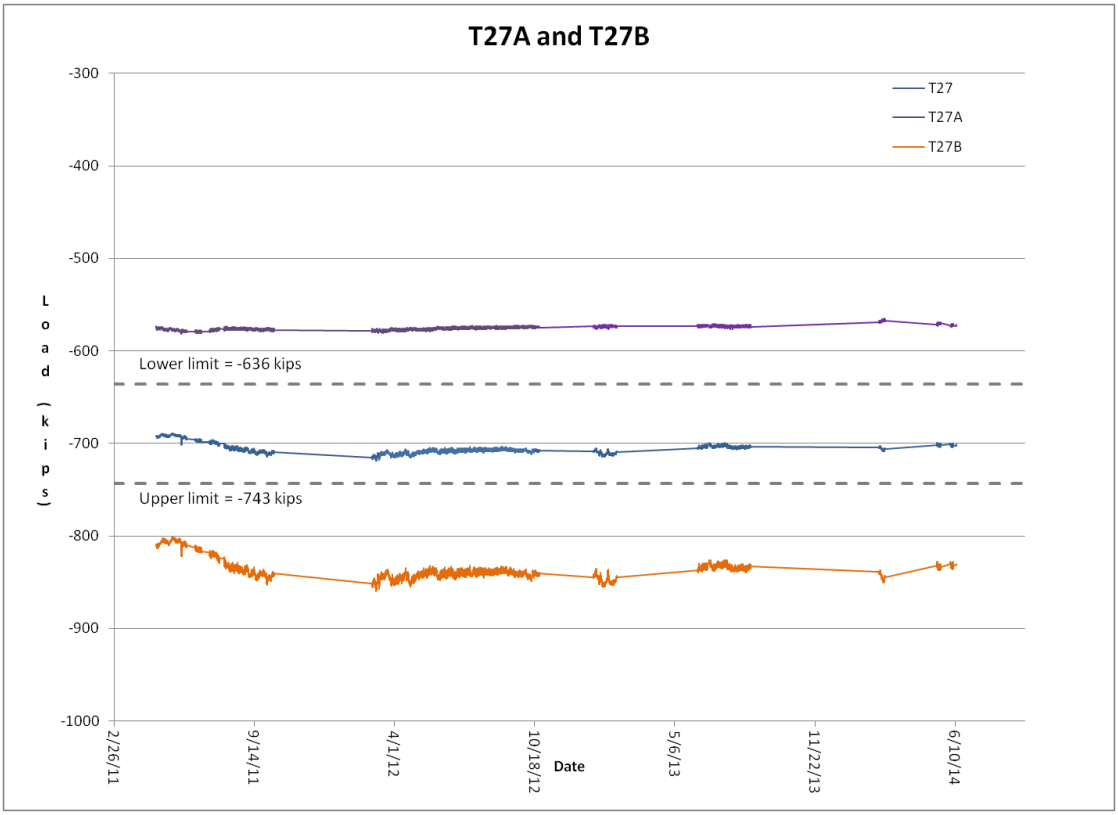

T19 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T19 norm
T19A norm
T19B norm
Initial tendon load (kips):
T19= -716
T19A= -822
T19B = -611
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

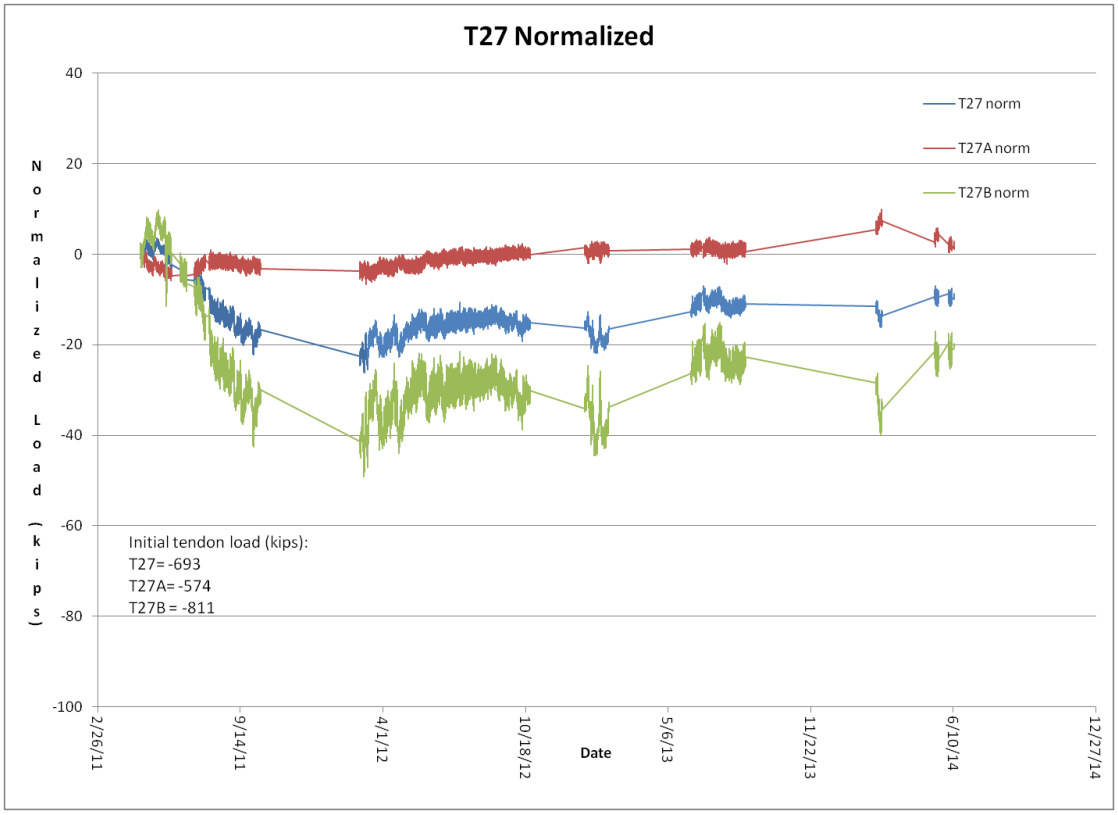

T19 Relative Temperature
T19B_TCG_A1018E8
T19A_TCG_A10191F
Norm_T19B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

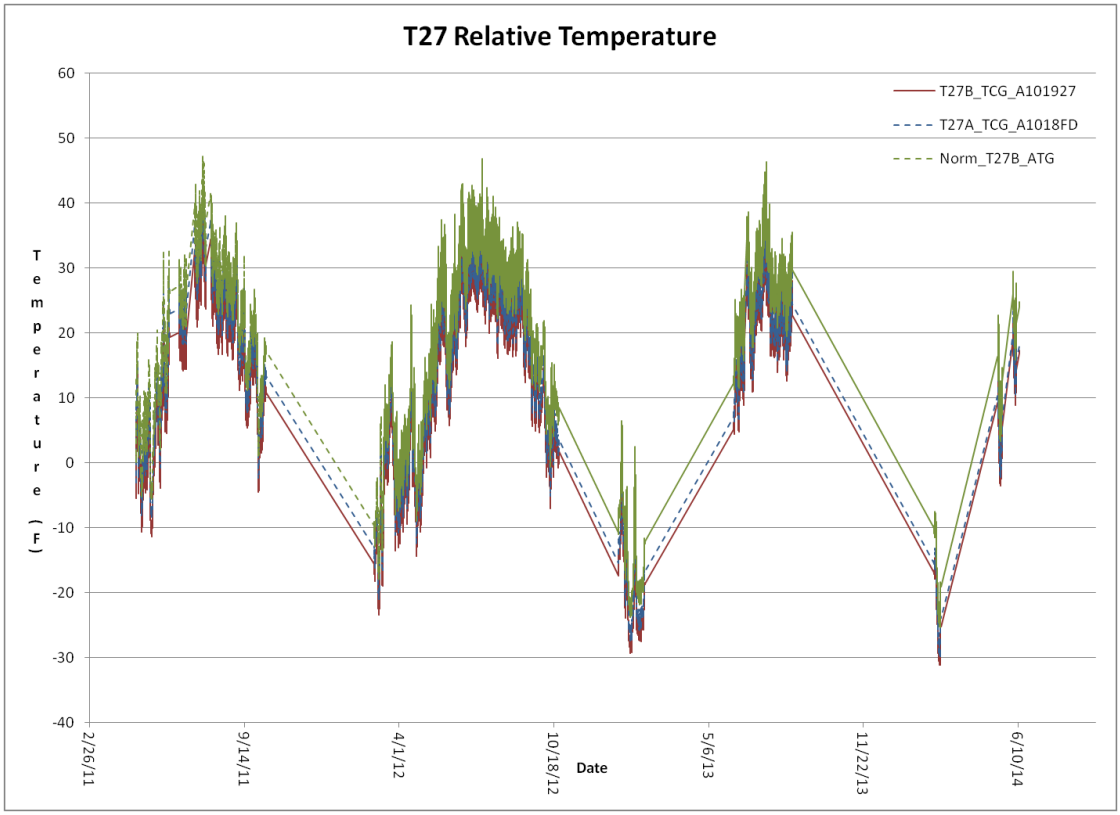

T19 Absolute Temperature
HRC_ATG
T19B_ATG_B313038
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

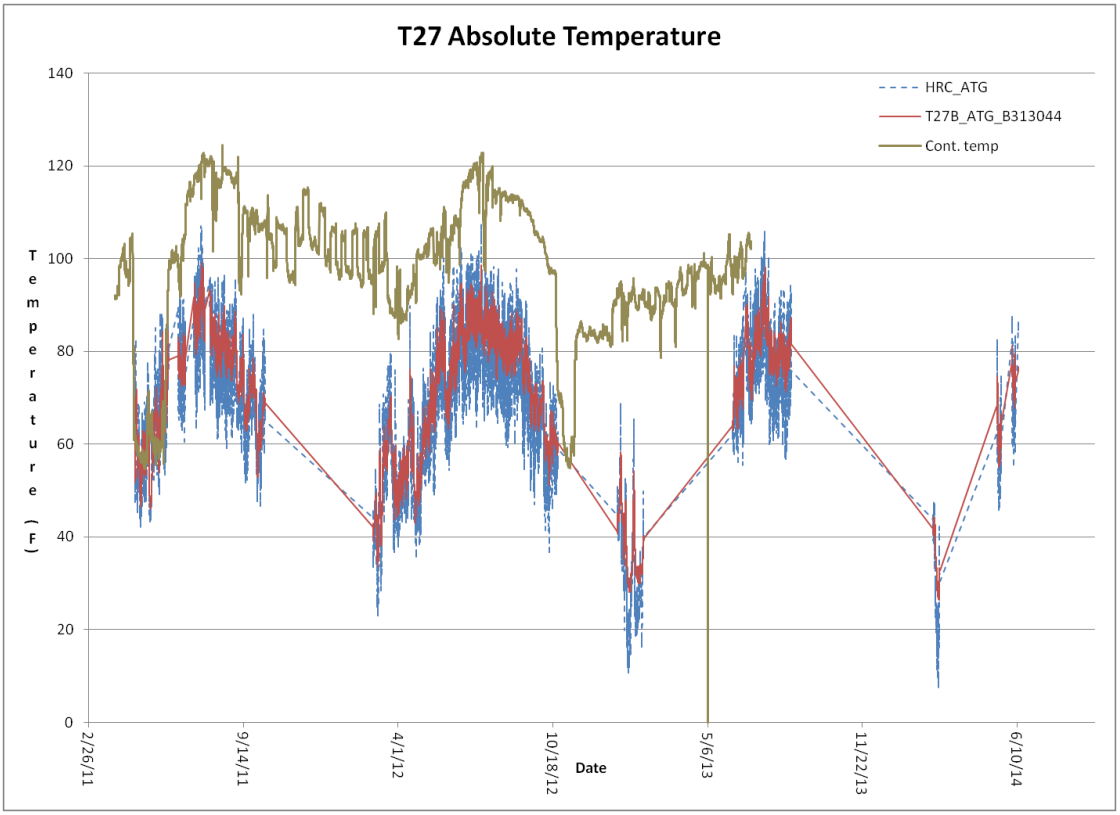
Tendon 27


T27
HRC_ATG
T27B_ATG_B313044
Cont temp
Cont Pres
T27A_TCG_A1018FD
T27B_TCG_A101927
T27
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-680
-690
-700
-710
-720
-730
-740
-750
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

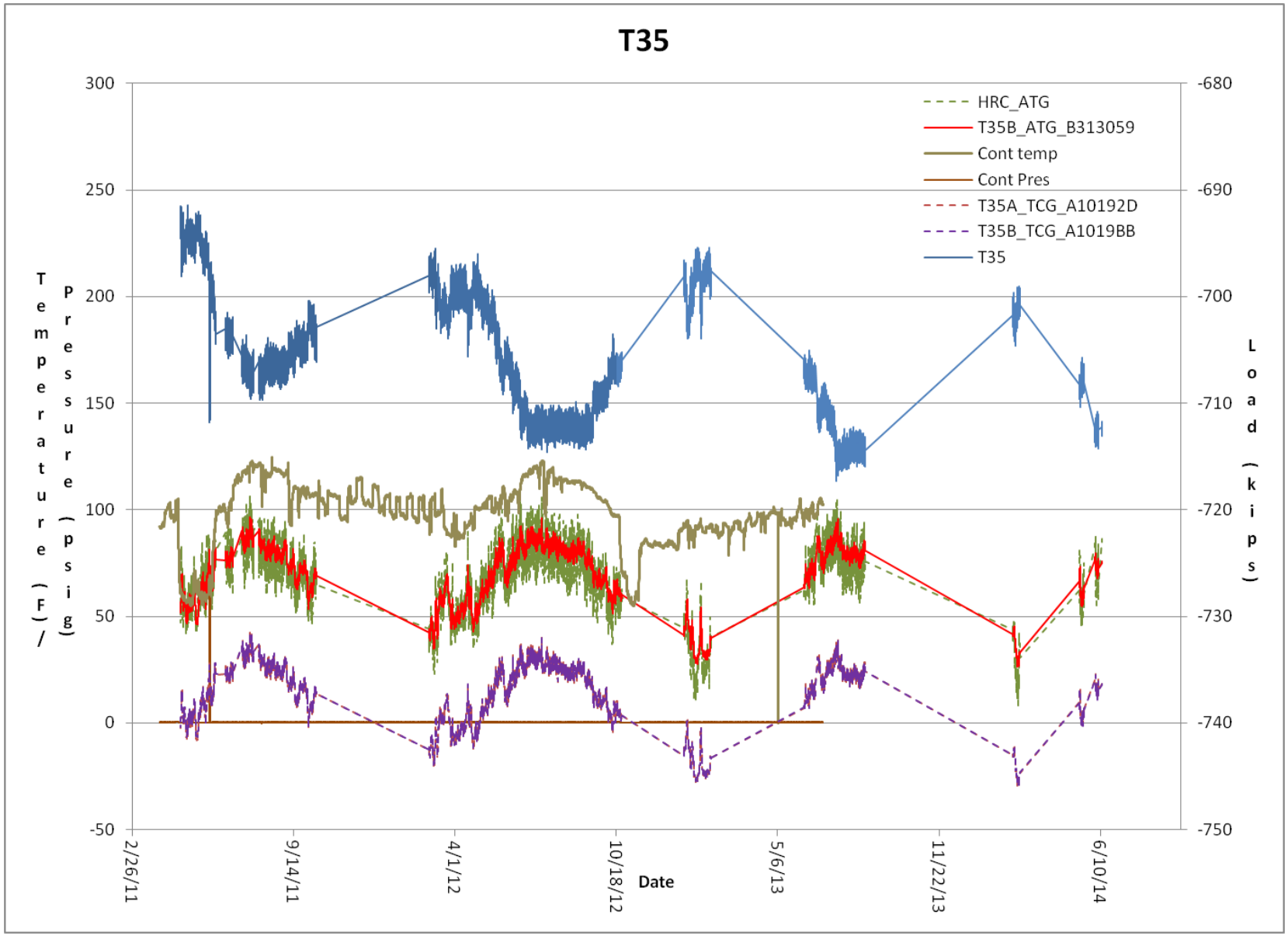

T27A and T27B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T27
T27A
T27B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

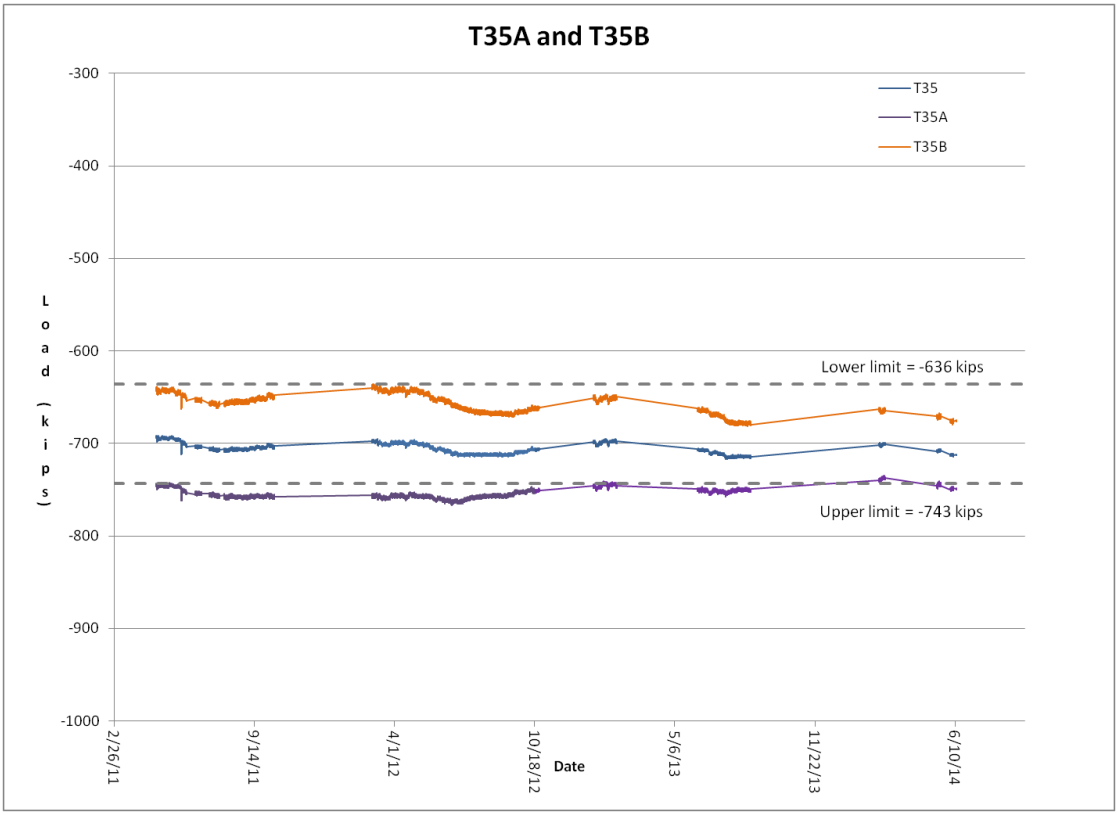

T27 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T27 norm
T27A norm
T27B norm
Initial tendon load (kips):
T27= -693
T27A= -574
T27B = -811
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

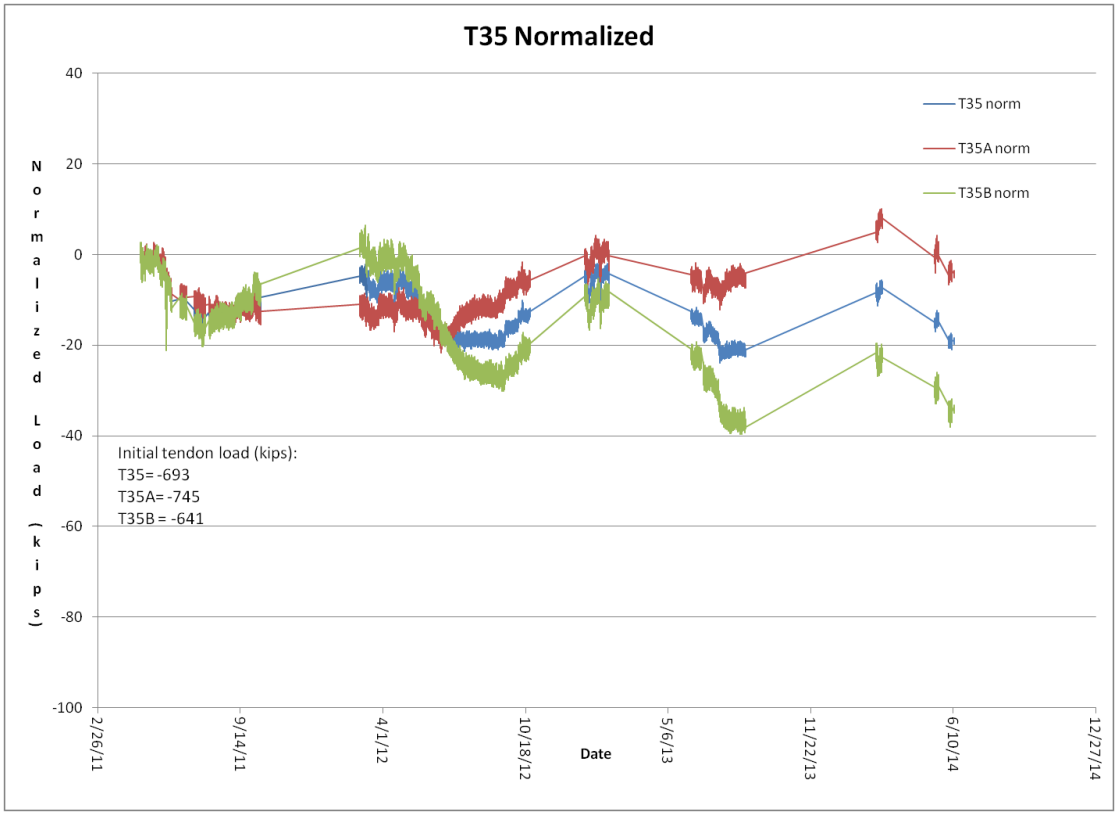

T27 Relative Temperature
T27B_TCG_A101927
T27A_TCG_A1018FD
Norm_T27B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

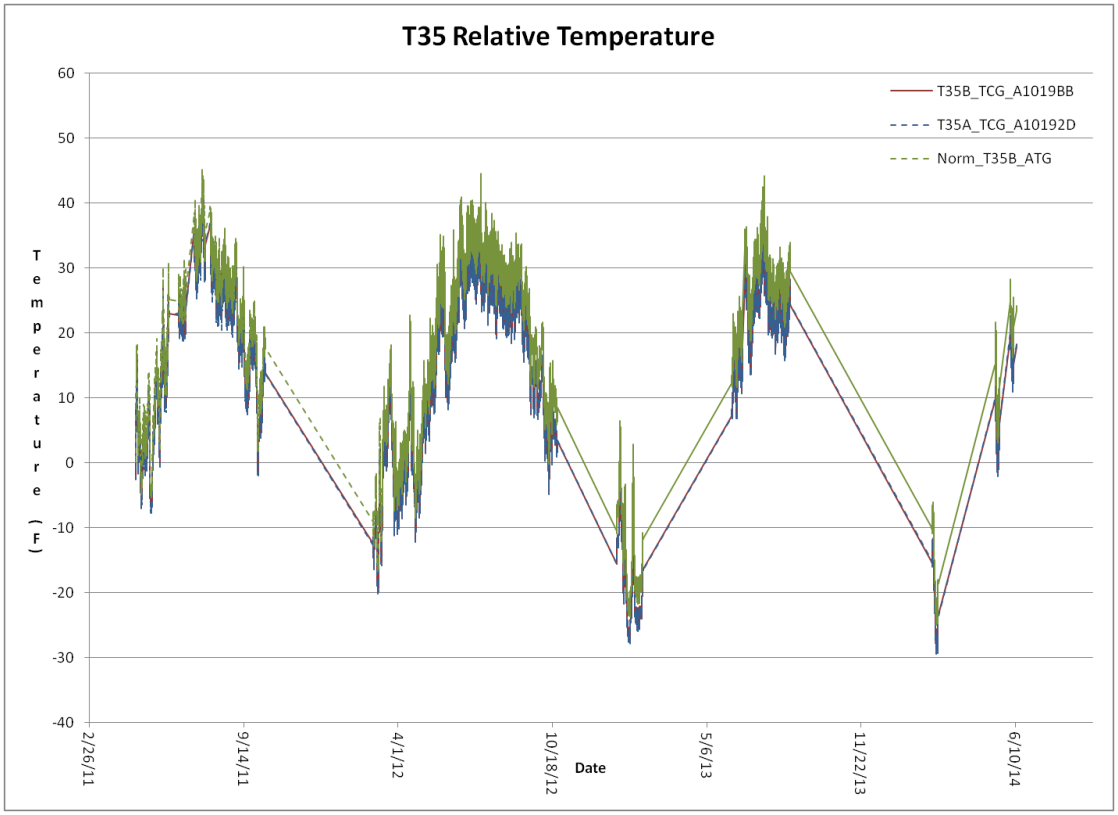

T27 Absolute Temperature
HRC_ATG
T27B_ATG_B313044
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

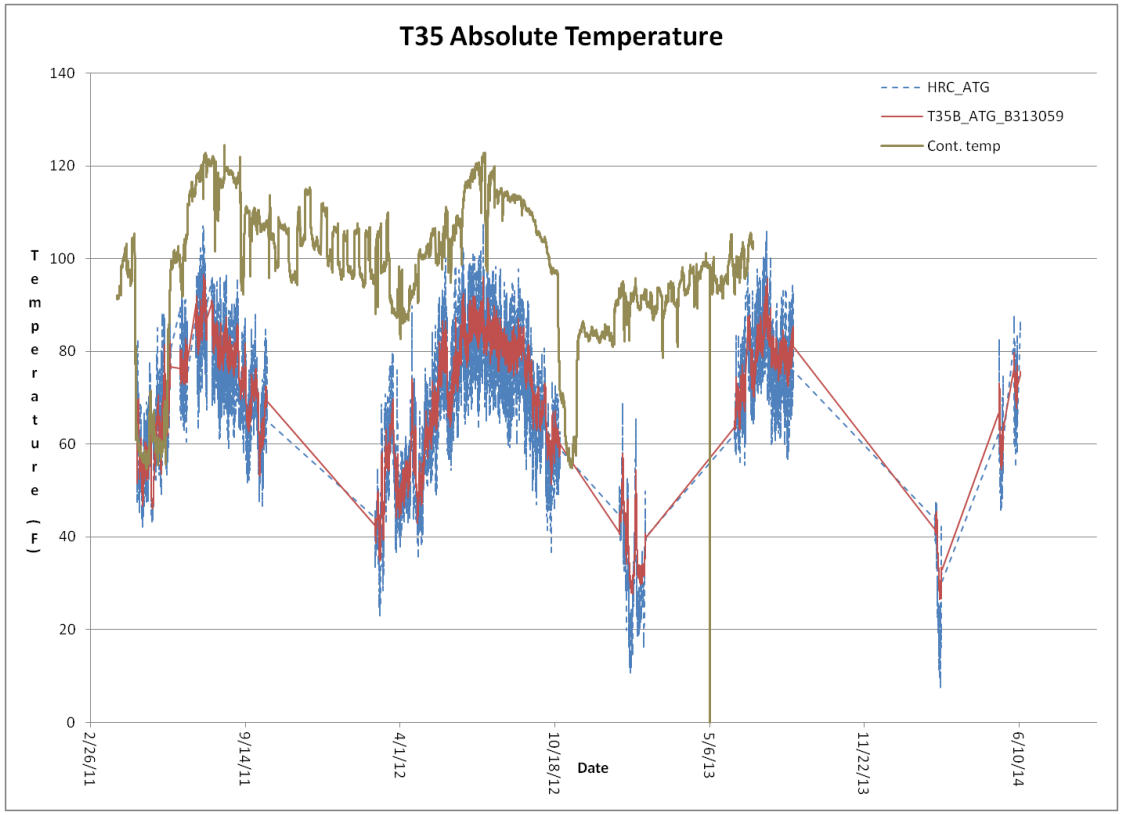
Tendon 35


T35
HRC_ATG
T35B_ATG_B313059
Cont temp
Cont Pres
T35A_TCG_A10192D
T35B_TCG_A1019BB
T35
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-680
-690
-700
-710
-720
-730
-740
-750
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

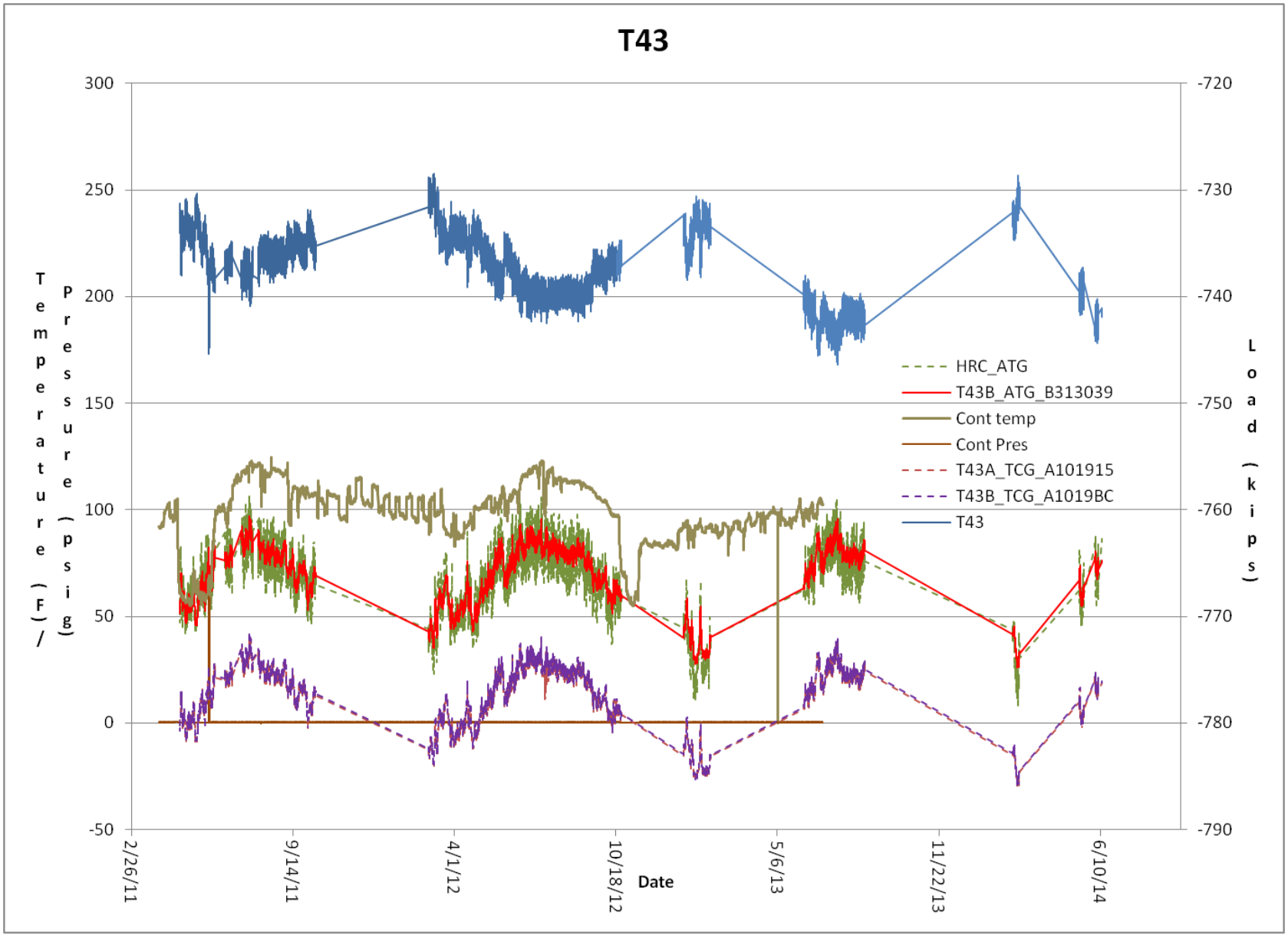

T35A and T35B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T35
T35A
T35B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

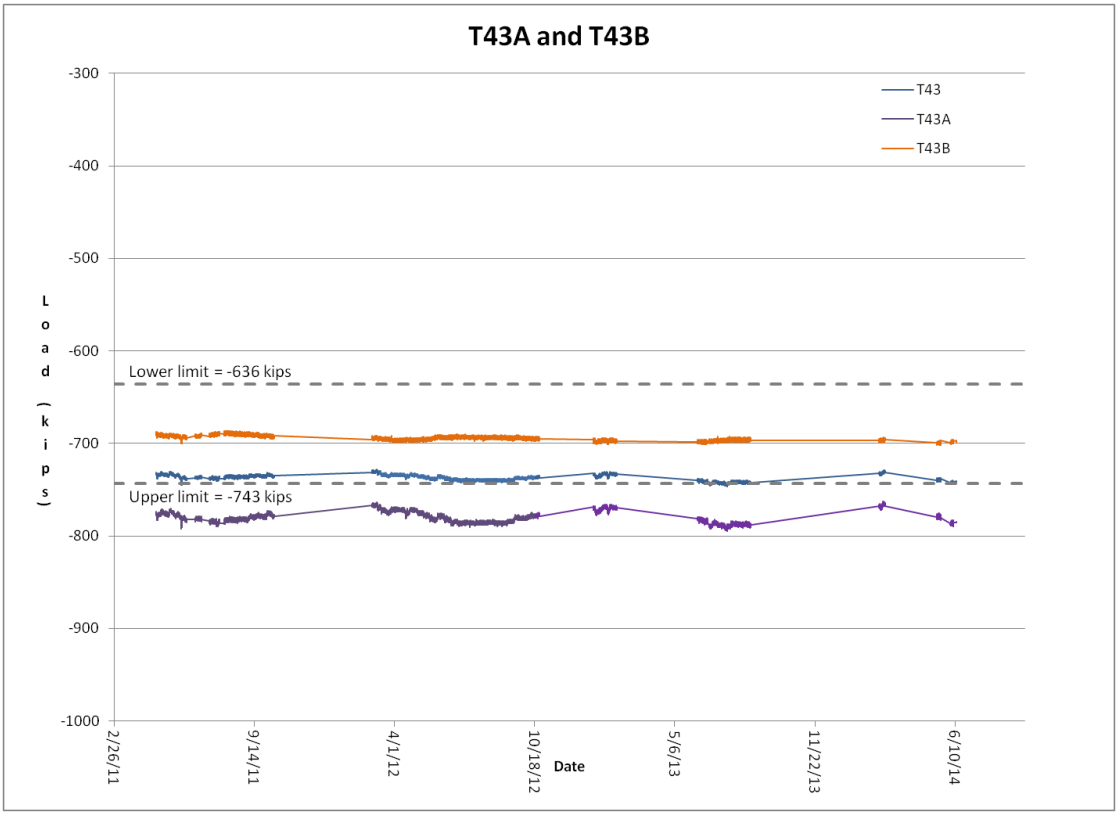

T35 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T35 norm
T35A norm
T35B norm
Initial tendon load (kips):
T35= -693
T35A= -745
T35B = -641
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

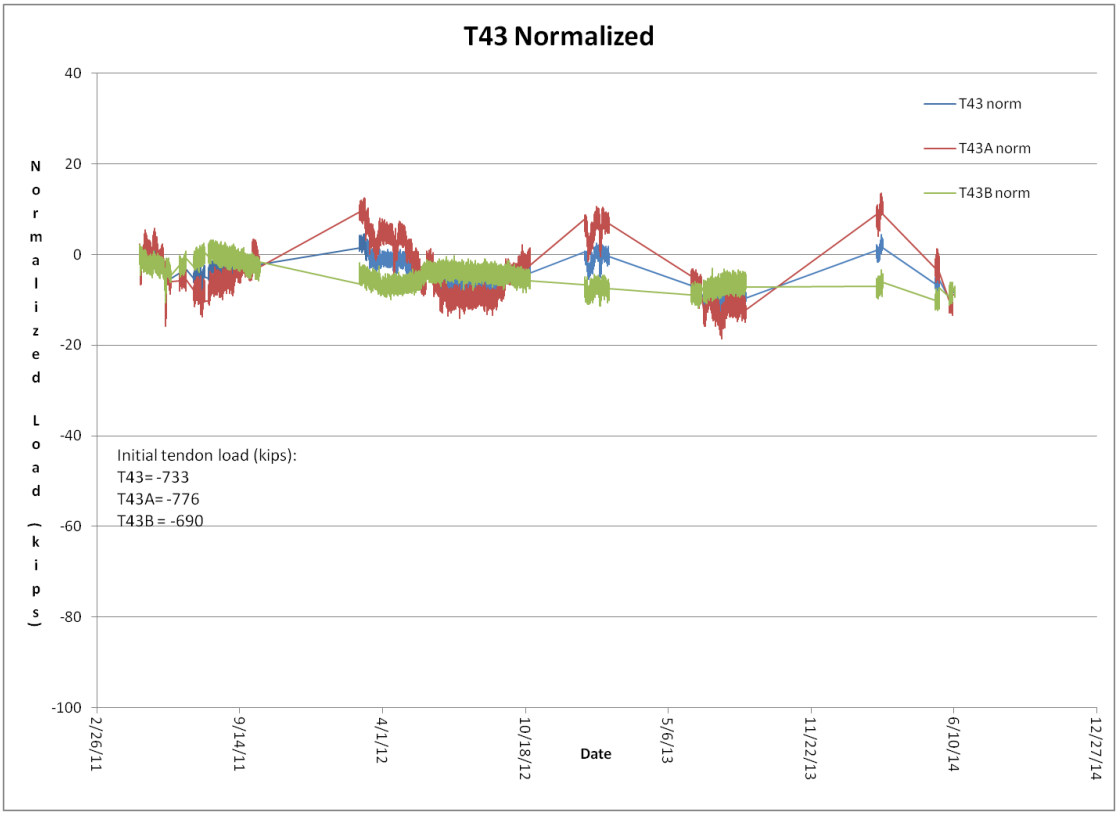

T35 Relative Temperature
T35B_TCG_A1019BB
T35A_TCG_A10192D
Norm_T35B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

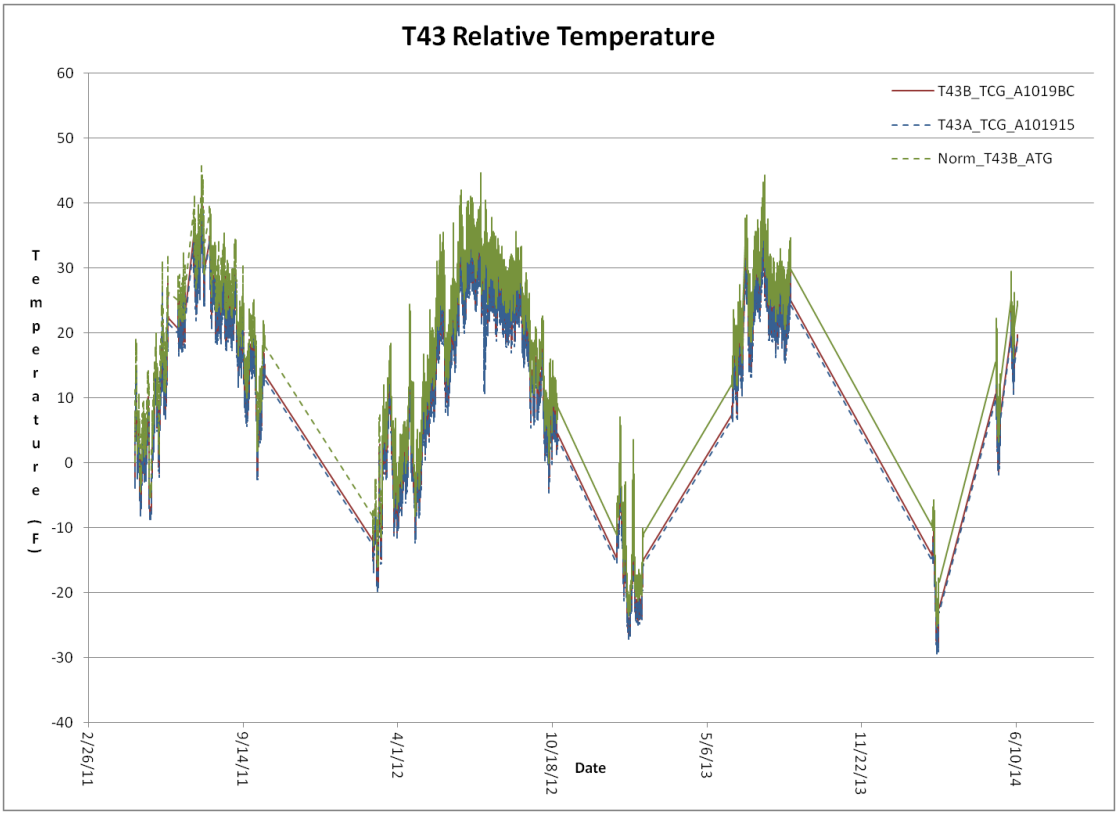

T35 Absolute Temperature
HRC_ATG
T35B_ATG_B313059
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

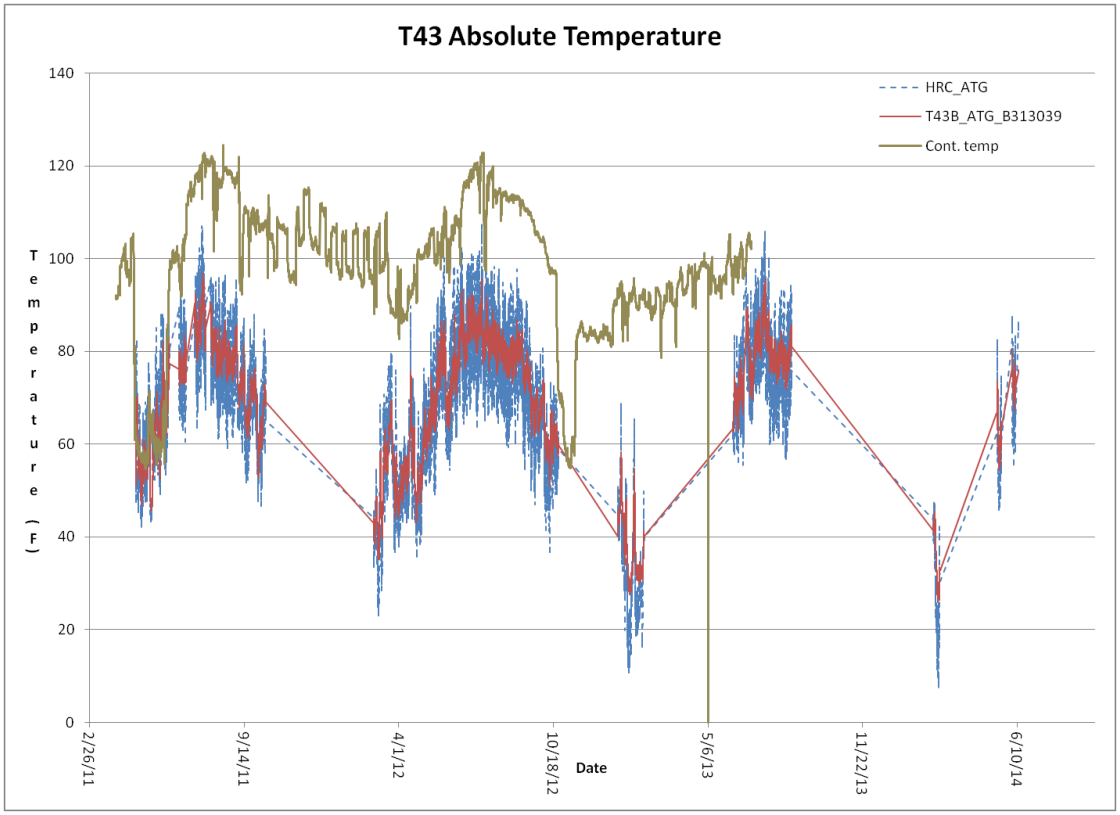
Tendon 43


T43
300
250
200
150
100
50
0
-50
-720
-730
-740
-750
-760
-770
-780
-790
Temperature (F) / Pressure (psig)
Load (kips)
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date
HRC_ATG
T43B_ATG_B313039
Cont temp
Cont Pres
T43A_TCG_A101915
T43B_TCG_A1019BC
T43

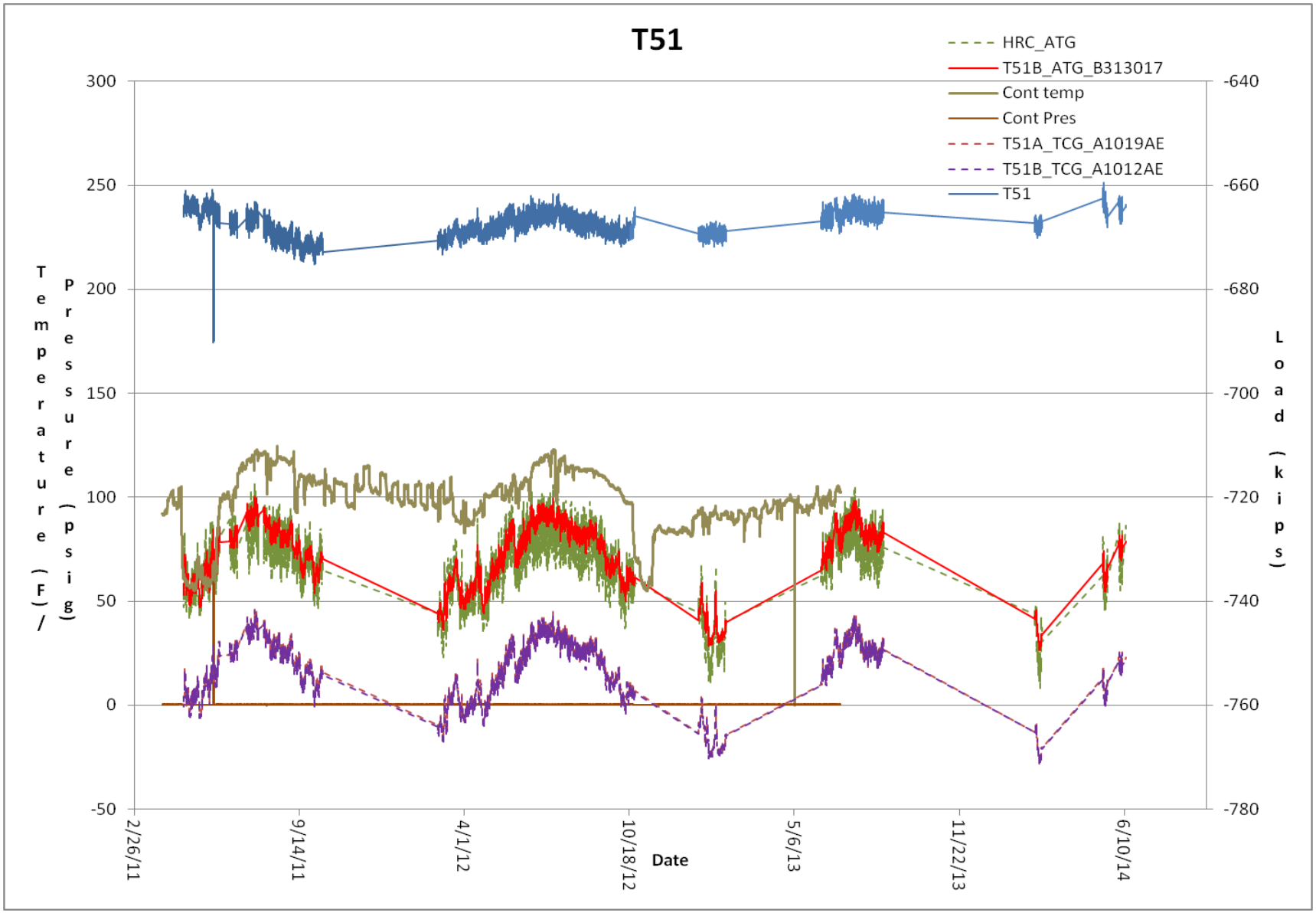

T43A and T43B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T43
T43A
T43B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

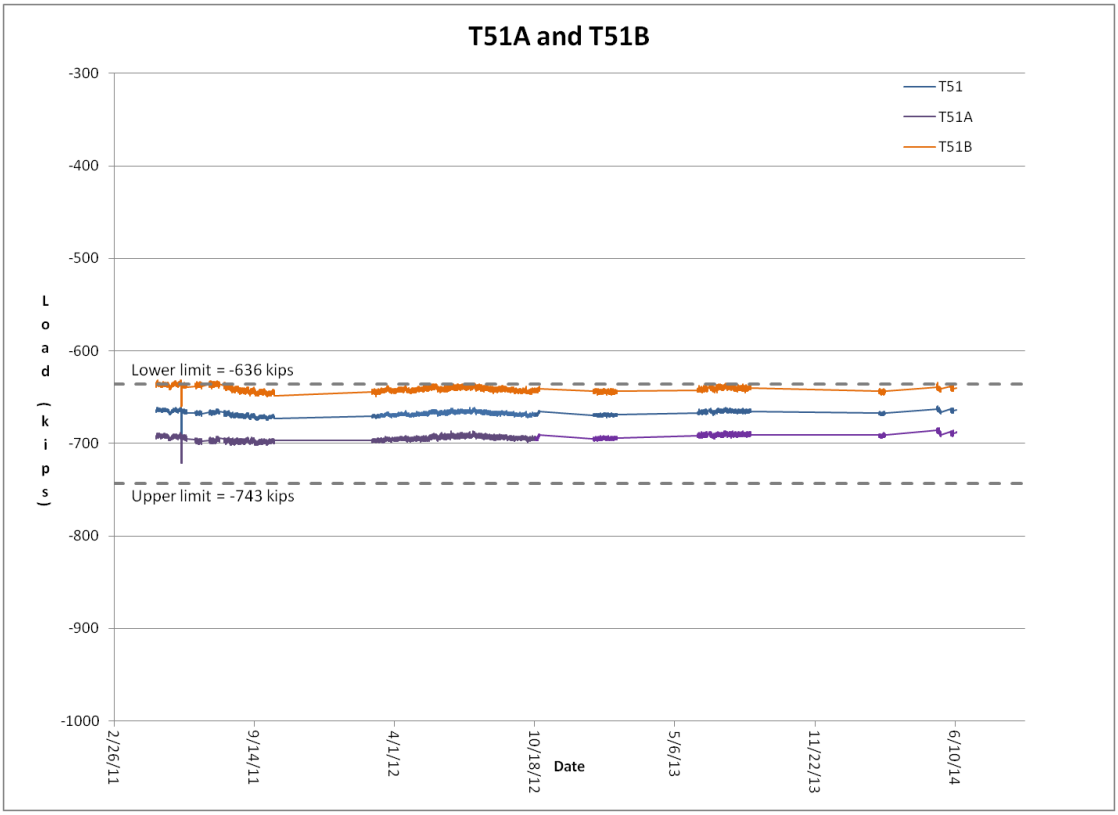

T43 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T43 norm
T43A norm
T43B norm
Initial tendon load (kips):
T43= -733
T43A= -776
T43B = -690
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

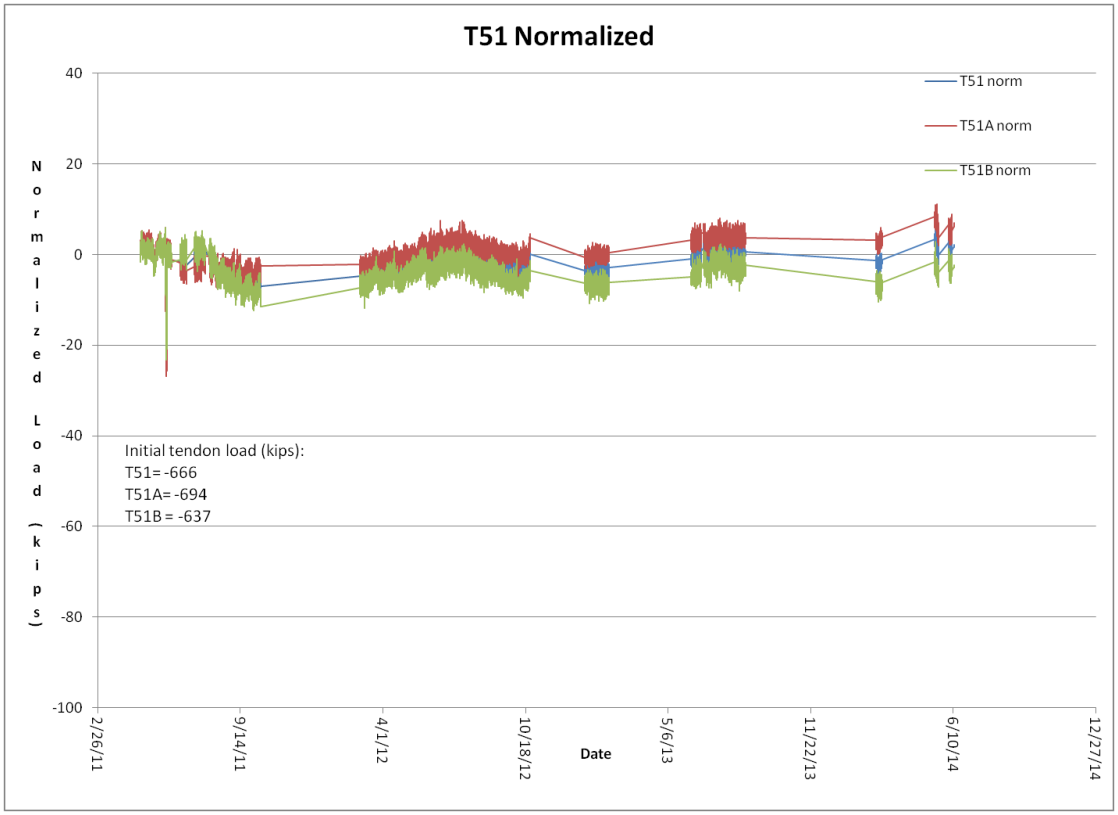

T43 Relative Temperature
T43B_TCG_A1019BC
T43A_TCG_A101915
Norm_T43B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

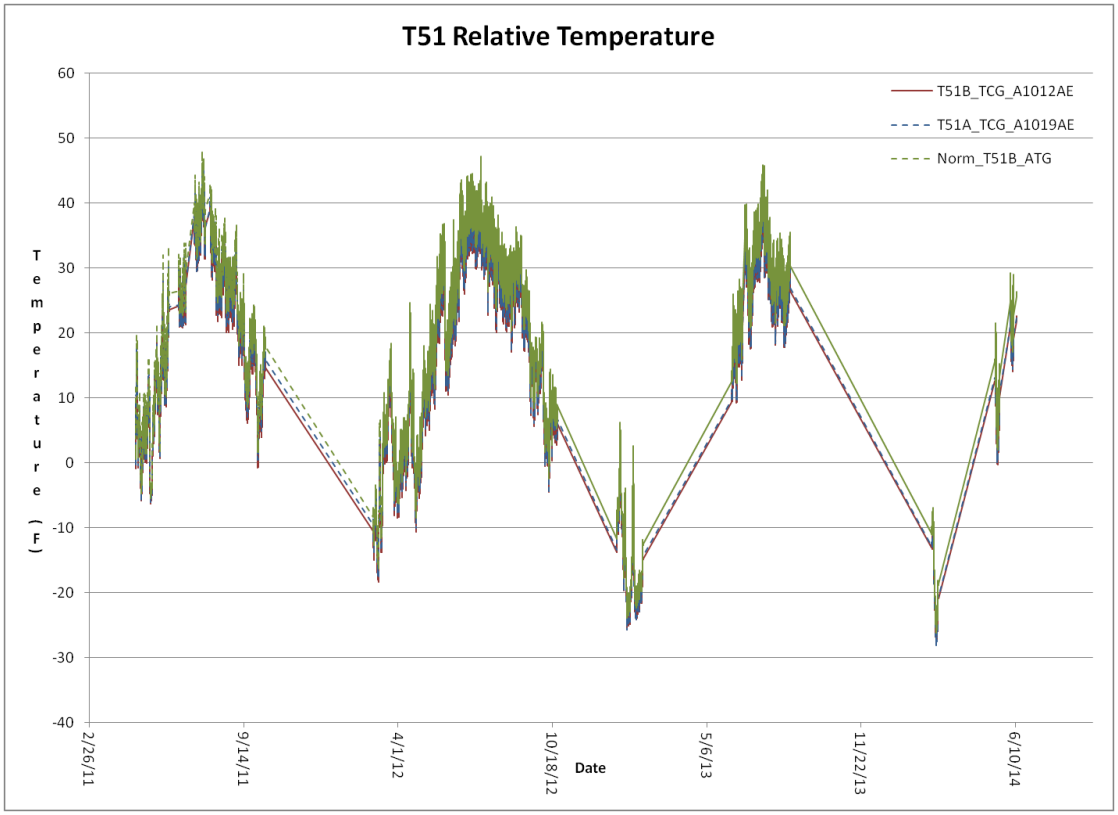

T43 Absolute Temperature
HRC_ATG
T43B_ATG_B313039
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

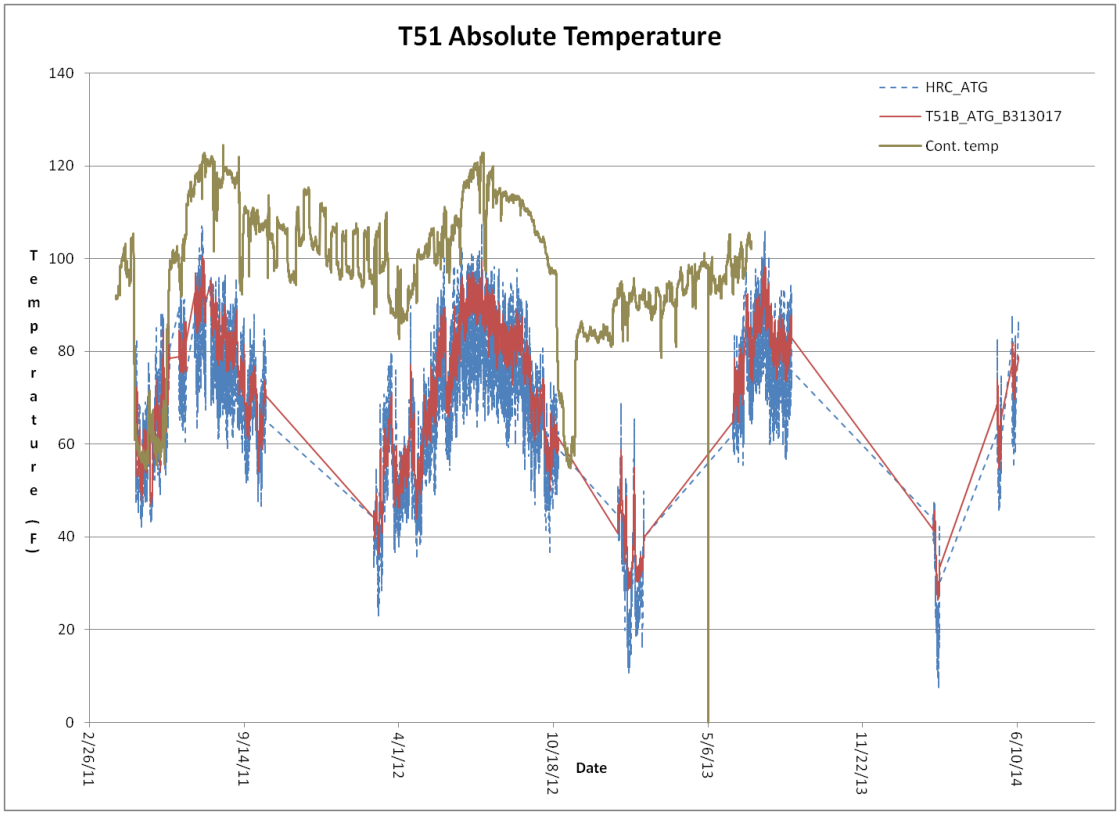
Tendon 51


T51
HRC_ATG
T51B_ATG_B313017
Cont temp
Cont Pres
T51A_TCG_A1019AE
T51B_TCG_A1012AE
T51
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-640
-660
-680
-700
-720
-740
-760
-780
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

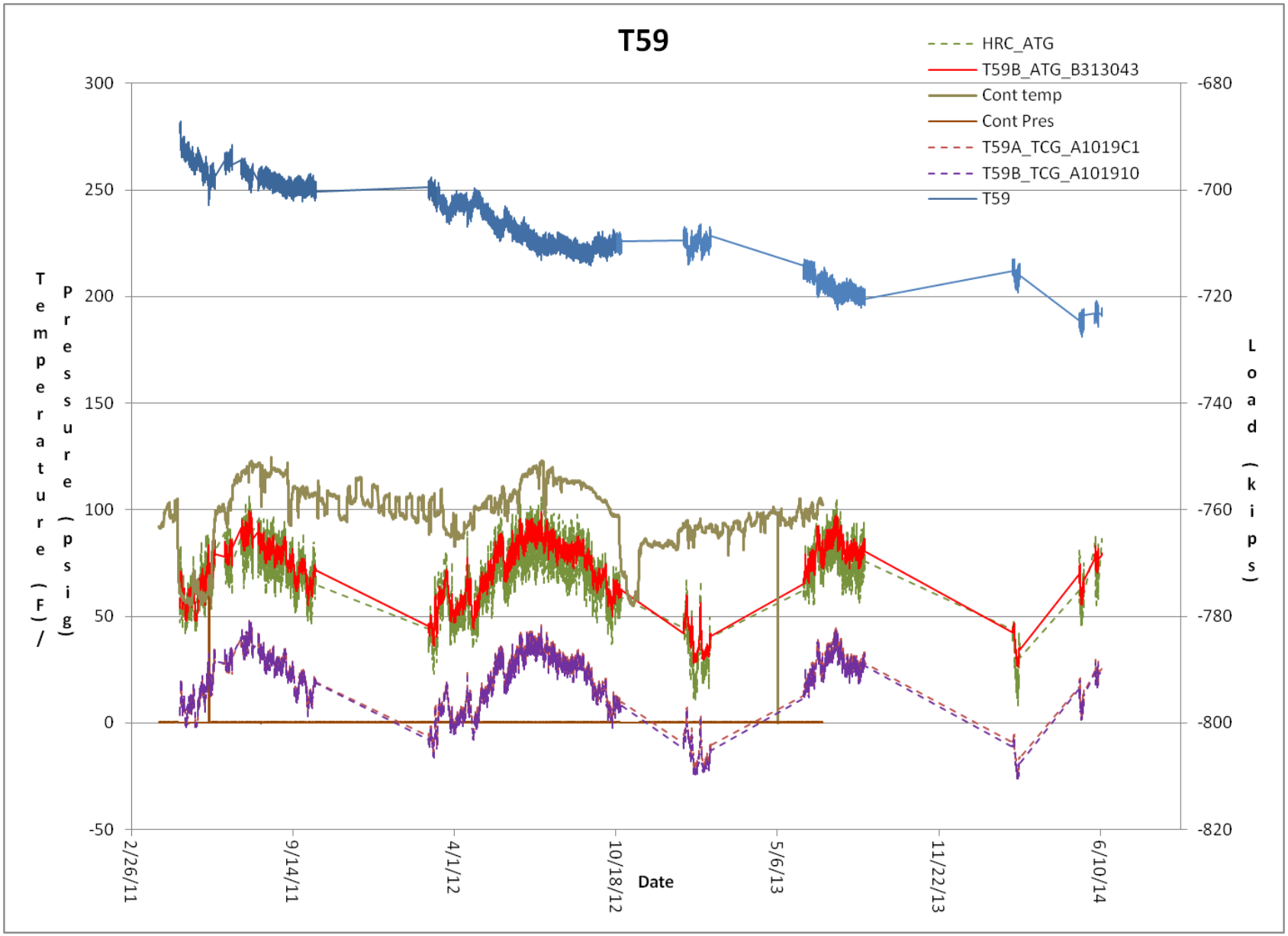

T51A and T51B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T51
T51A
T51B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

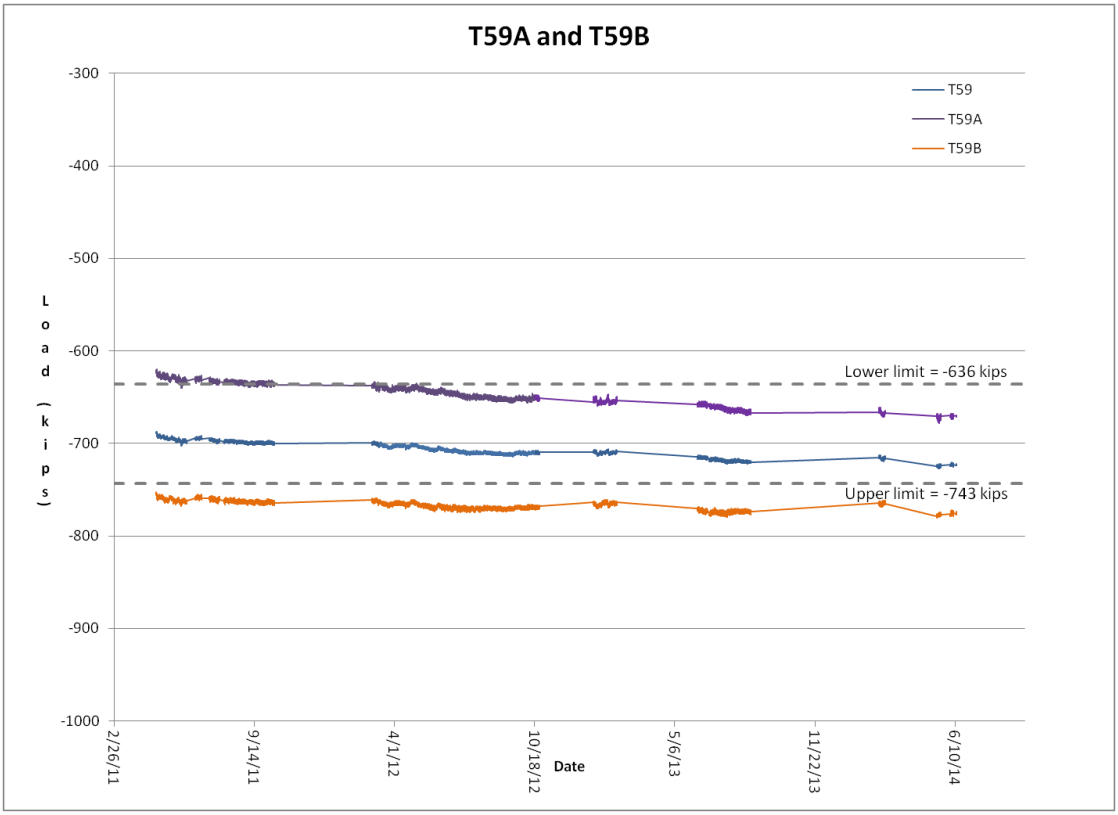

T51 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T51 norm
T51A norm
T51B norm
Initial tendon load (kips):
T51= -666
T51A= -694
T51B = -637
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

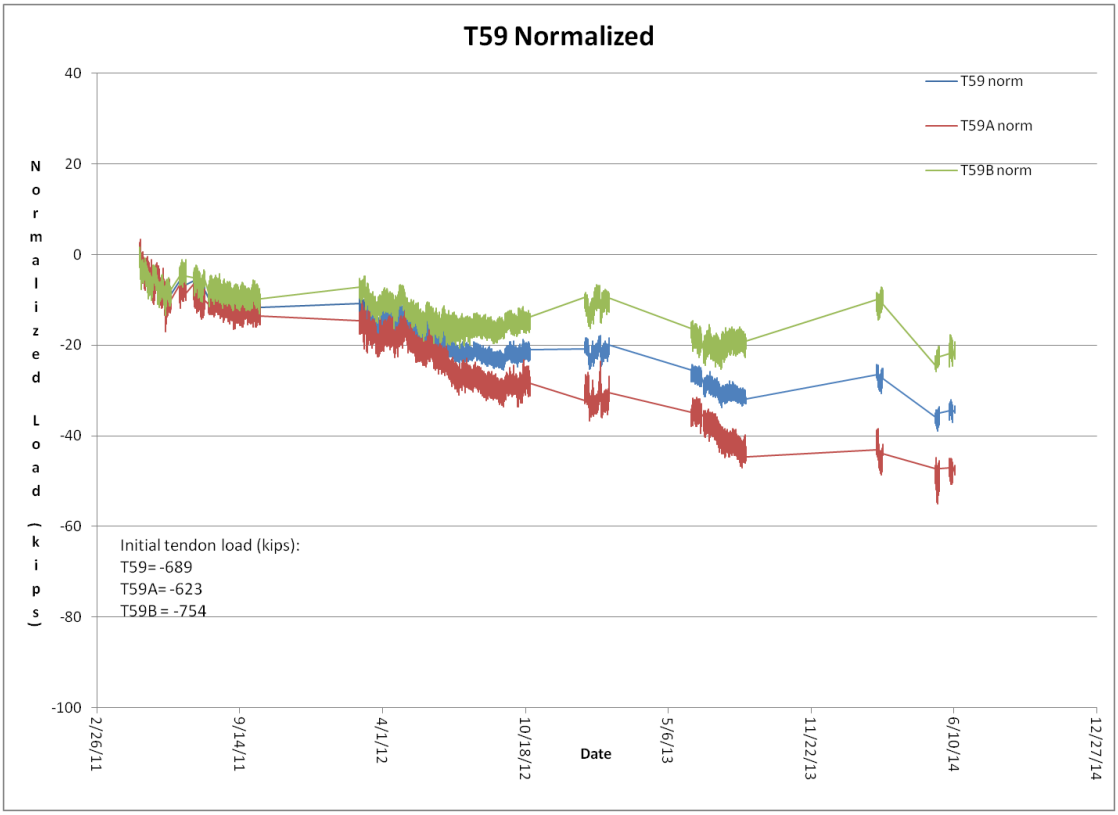

T51 Relative Temperature
T51B_TCG_A1012AE
T51A_TCG_A1019AE
Norm_T51B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

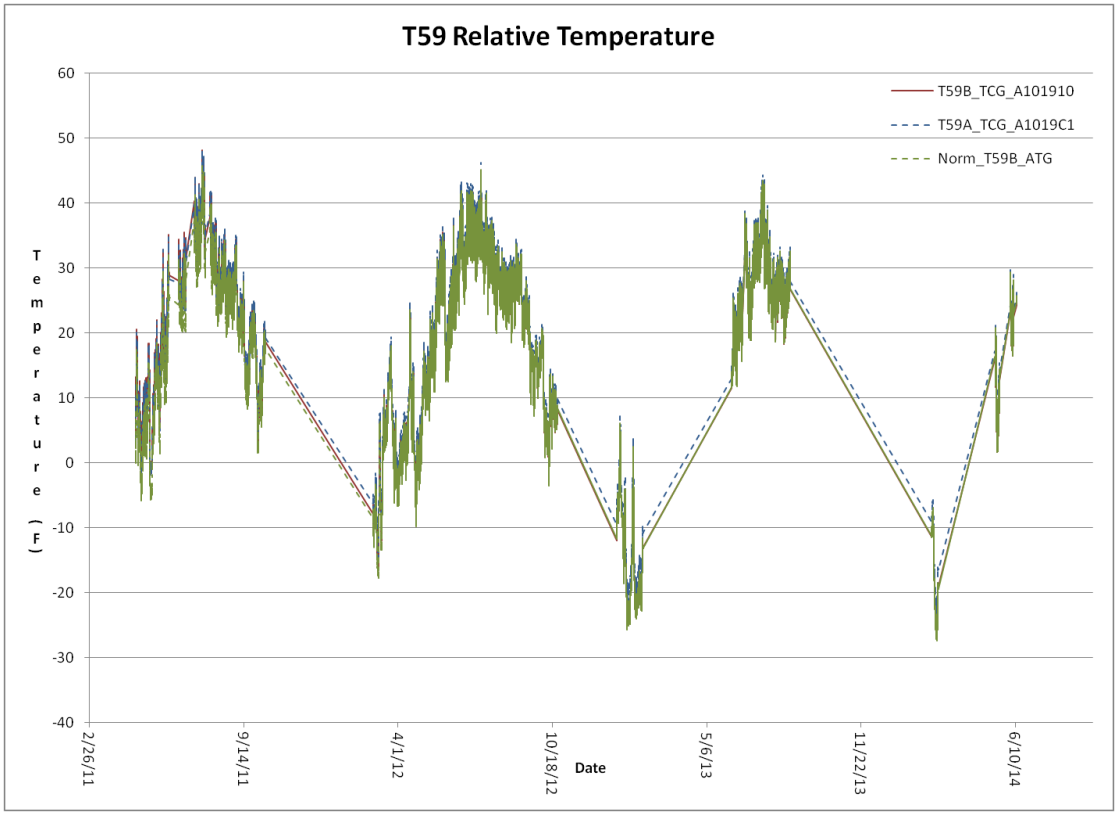

T51 Absolute Temperature
HRC_ATG
T51B_ATG_B313017
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

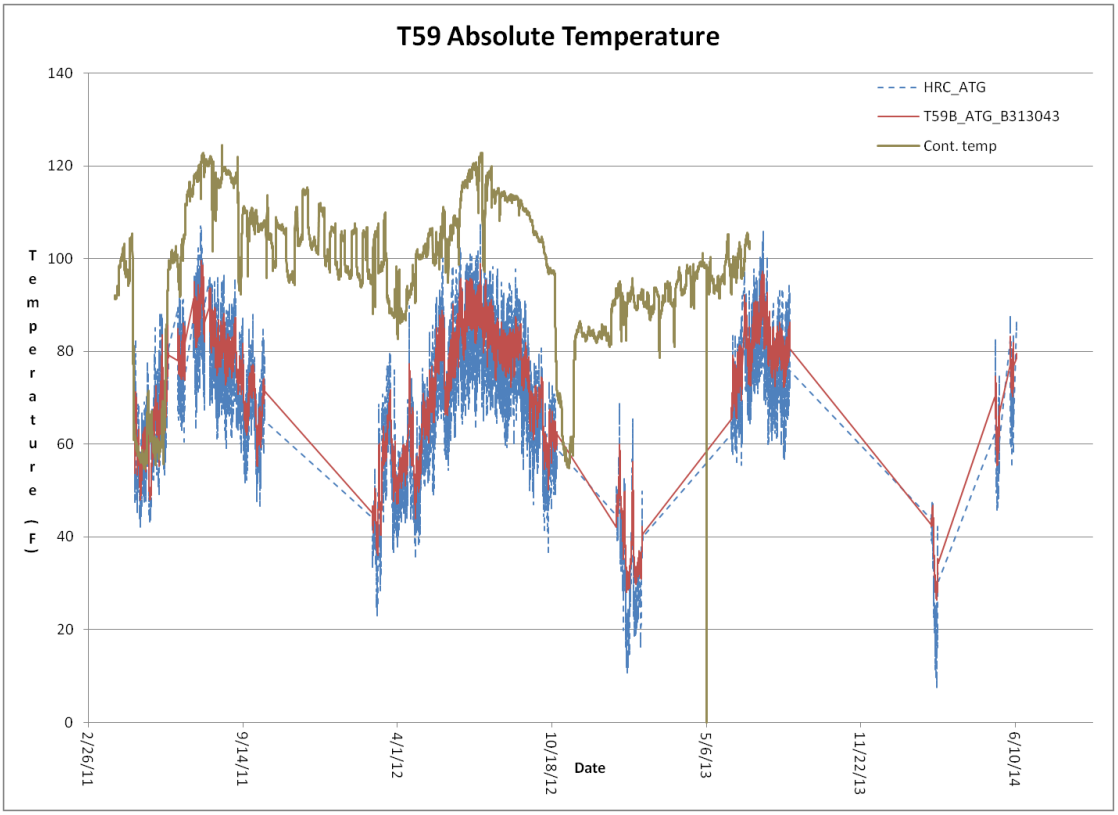
Tendon 59


T59
HRC_ATG
T59B_ATG_B313043
Cont temp
Cont Pres
T59A_TCG_A1019C1
T59B_TCG_A101910
T59
300
250
200
150
100
50
0
-50
-680
-700
-720
-740
-760
-780
-800
-820
Temperature (F) / Pressure (psig)
Load (kips)
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

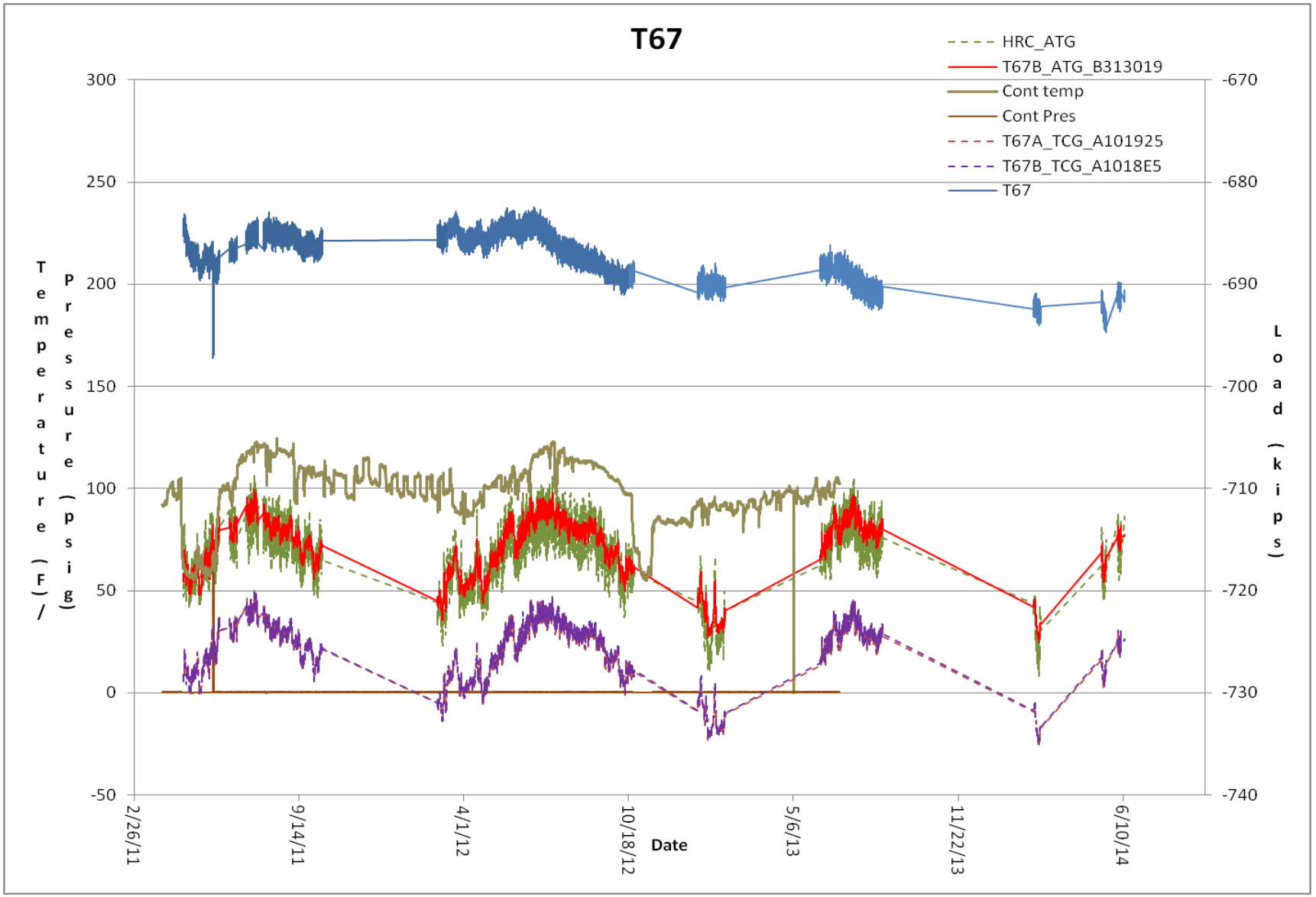

T59A and T59B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T59
T59A
T59B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

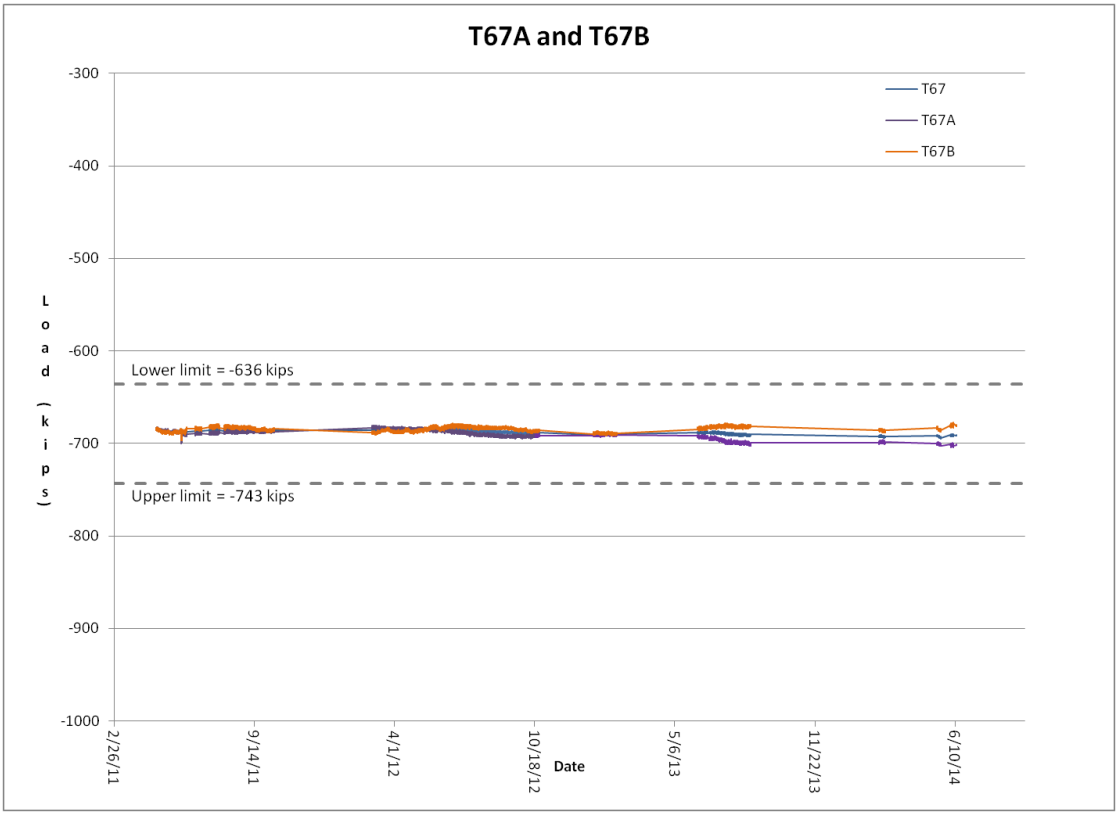

T59 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T59 norm
T59A norm
T59B norm
Initial tendon load (kips):
T59= -689
T59A= -623
T59B = -754
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

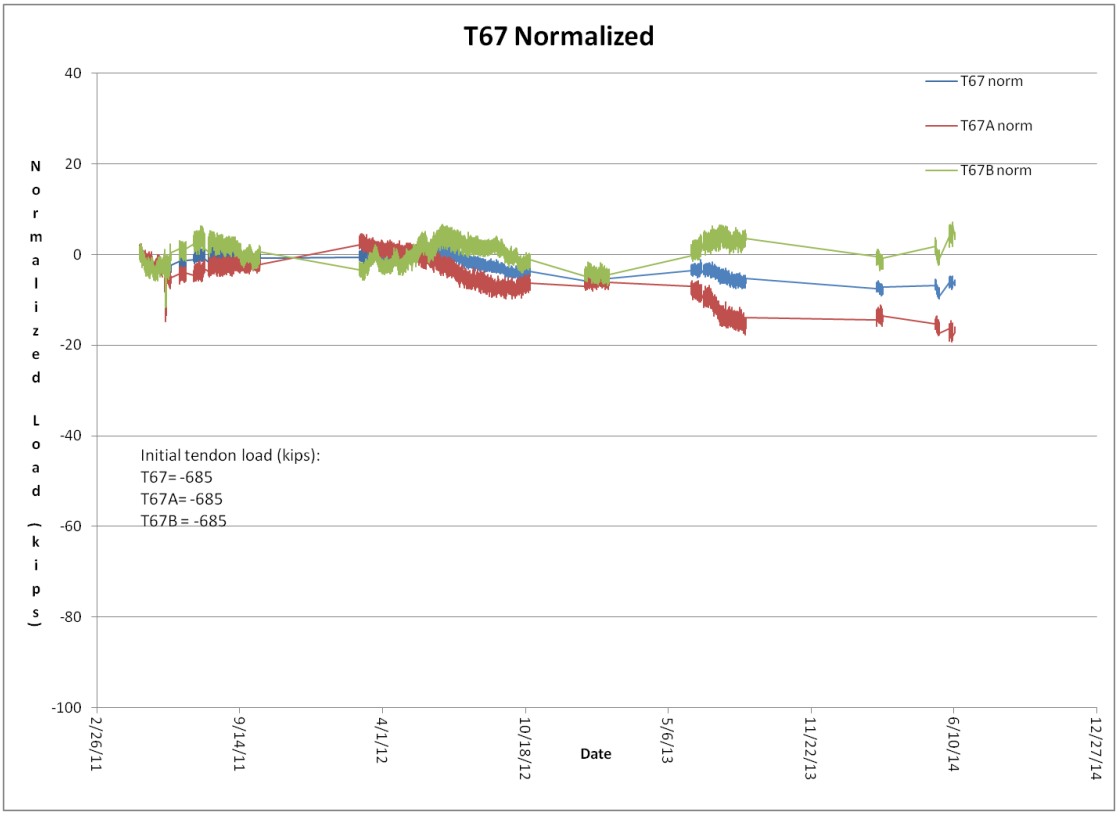

T59 Relative Temperature
T59B_TCG_A101910
T59A_TCG_A1019C1
Norm_T59B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

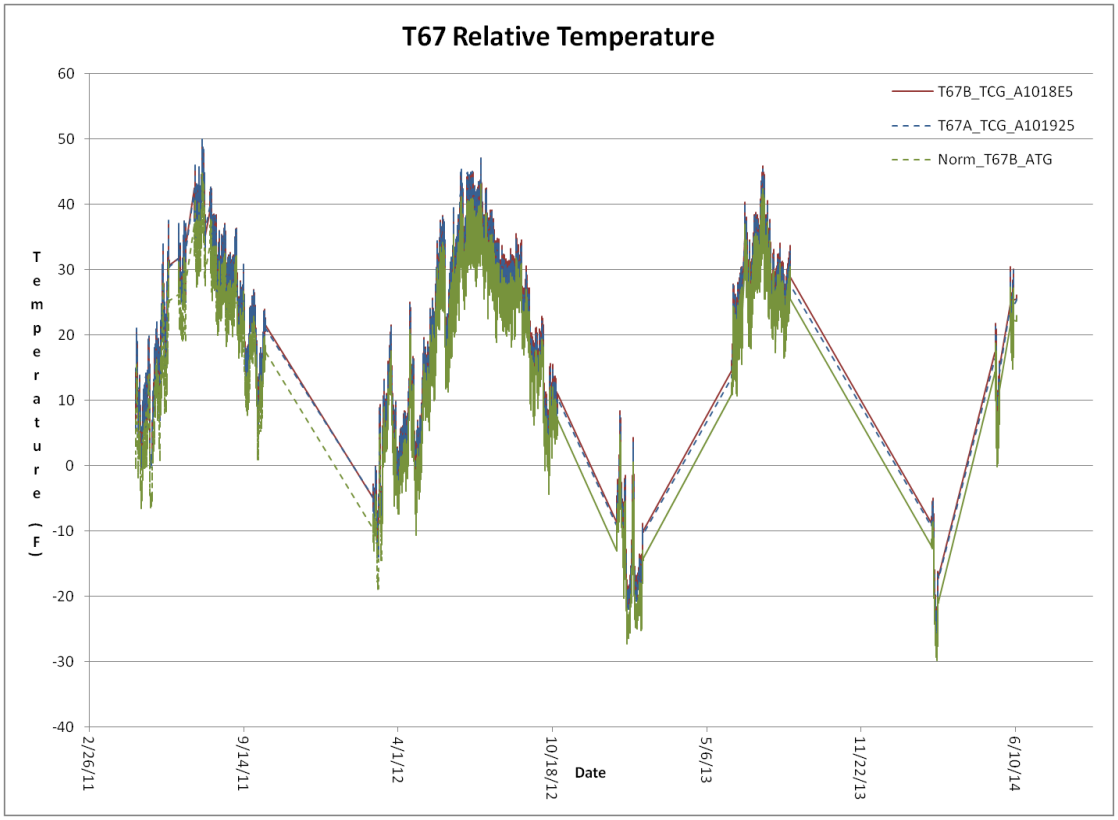

T59 Absolute Temperature
HRC_ATG
T59B_ATG_B313043
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

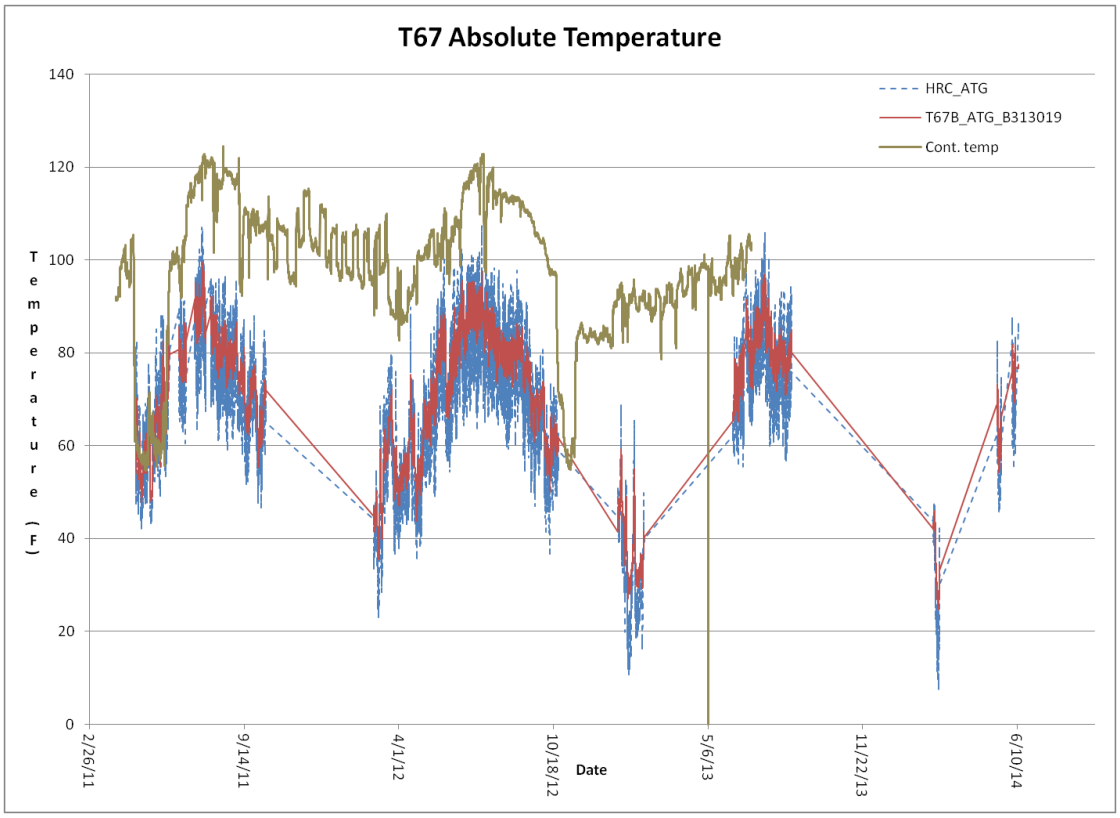
Tendon 67


T67
HRC_ATG
T67B_ATG_B313019
Cont temp
Cont Pres
T67A_TCG_A101925
T67B_TCG_A1018E5
T67
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-670
-680
-690
-700
-710
-720
-730
-740
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

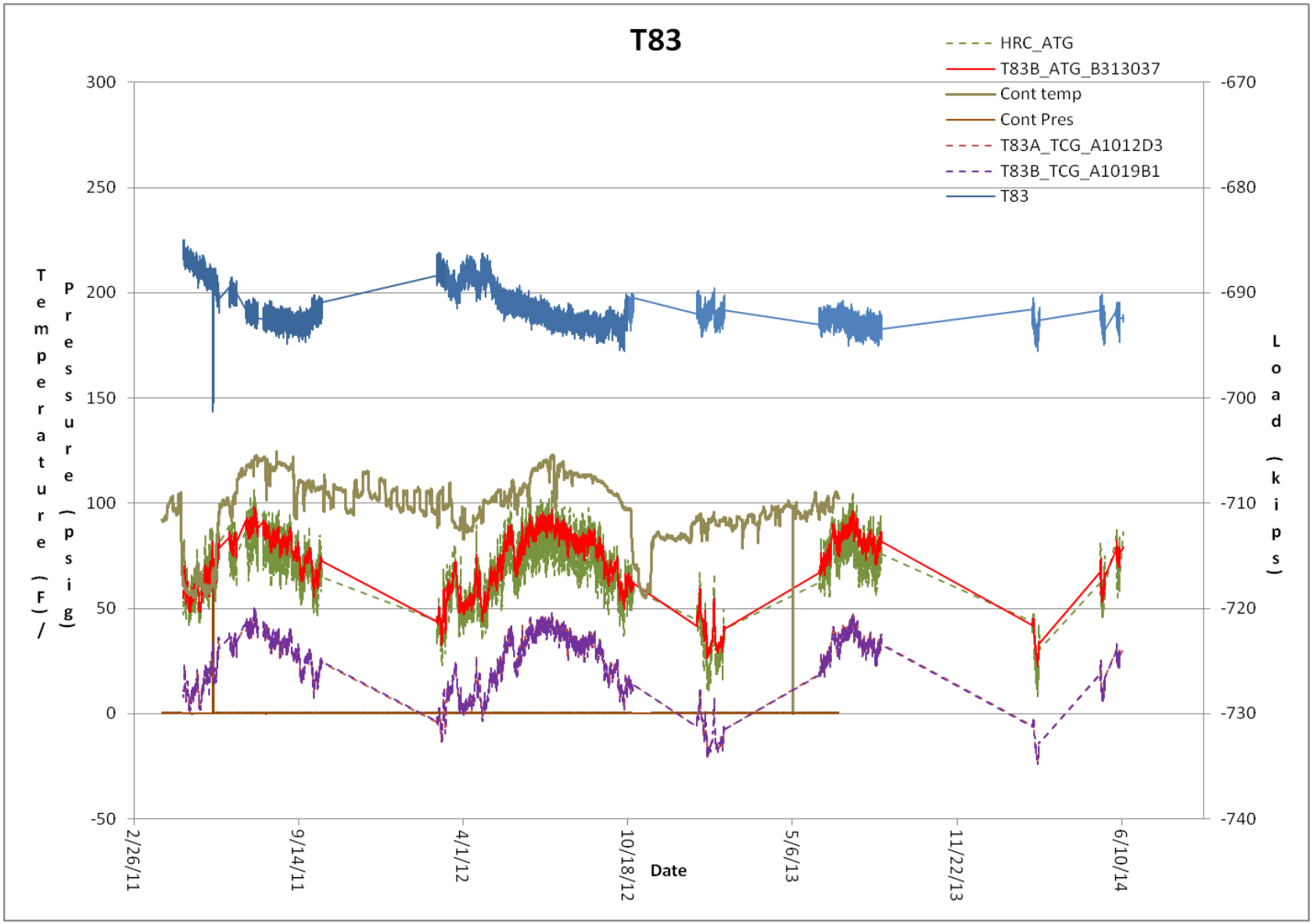

T67A and T67B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T67
T67A
T67B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

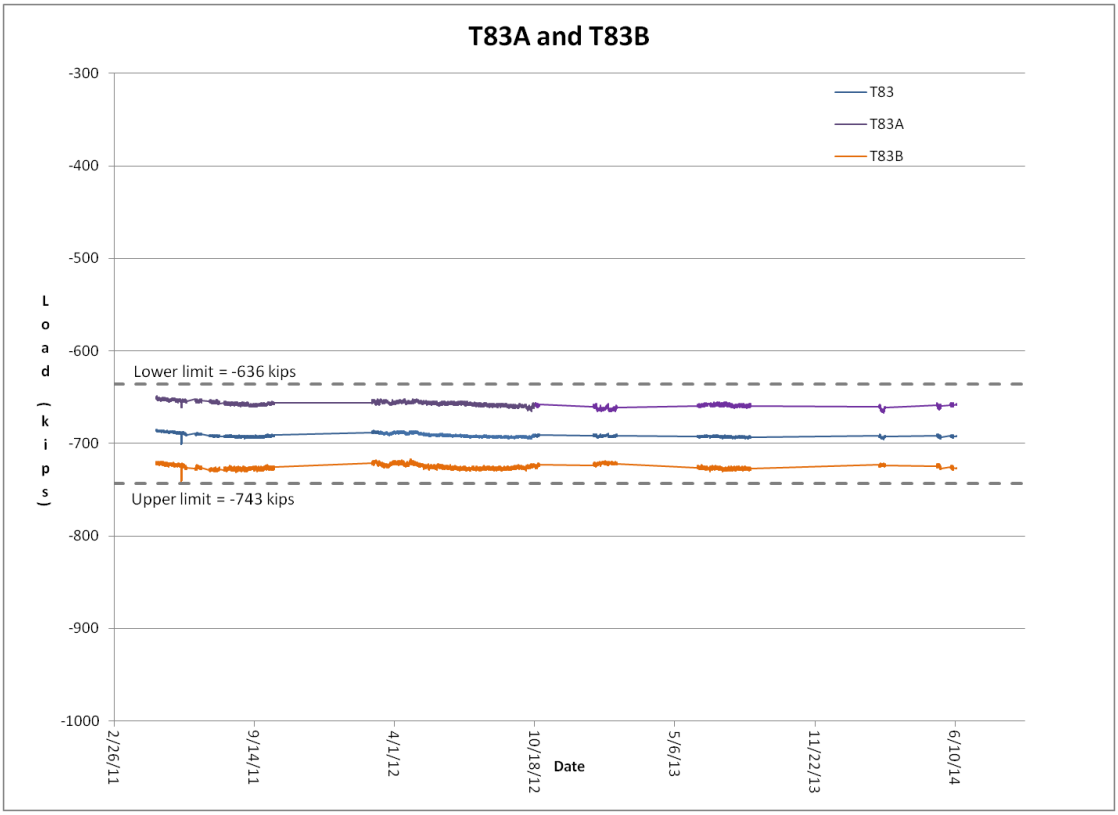

T67 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T67 norm
T67A norm
T67B norm
Initial tendon load (kips):
T67= -685
T67A= -685
T67B = -685
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

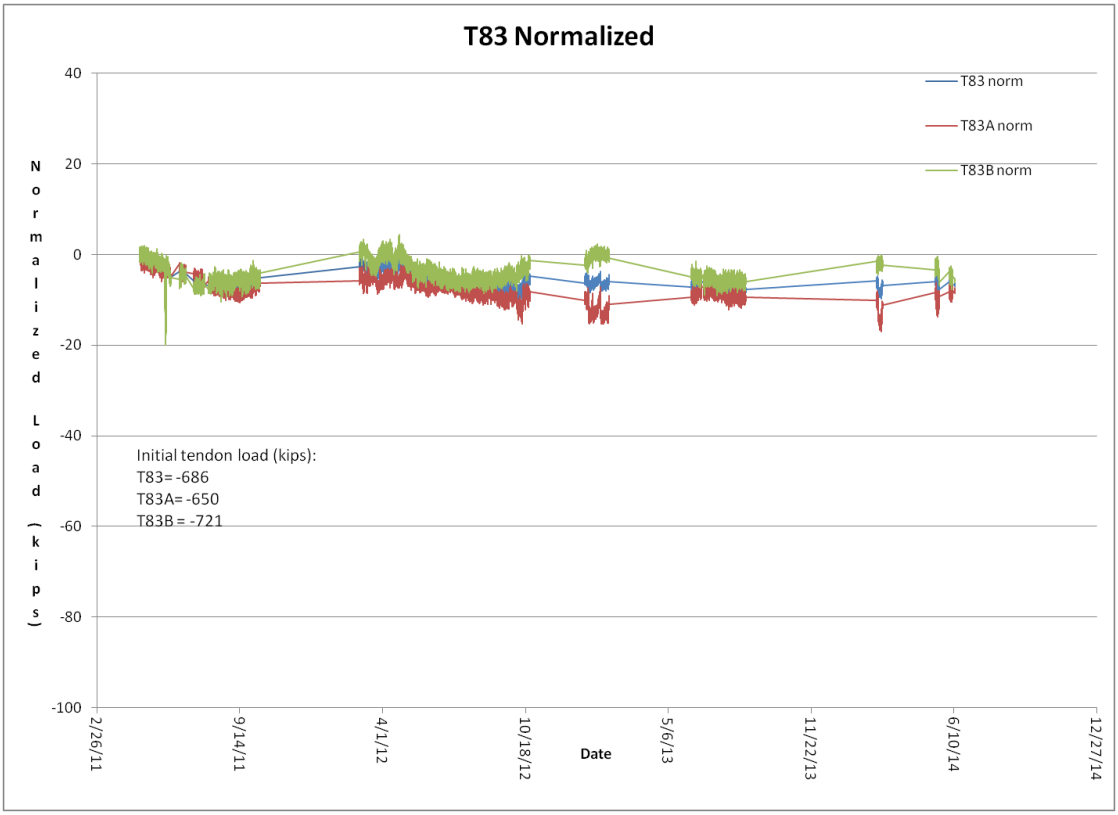

T67 Relative Temperature
T67B_TCG_A1018E5
T67A_TCG_A101925
Norm_T67B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

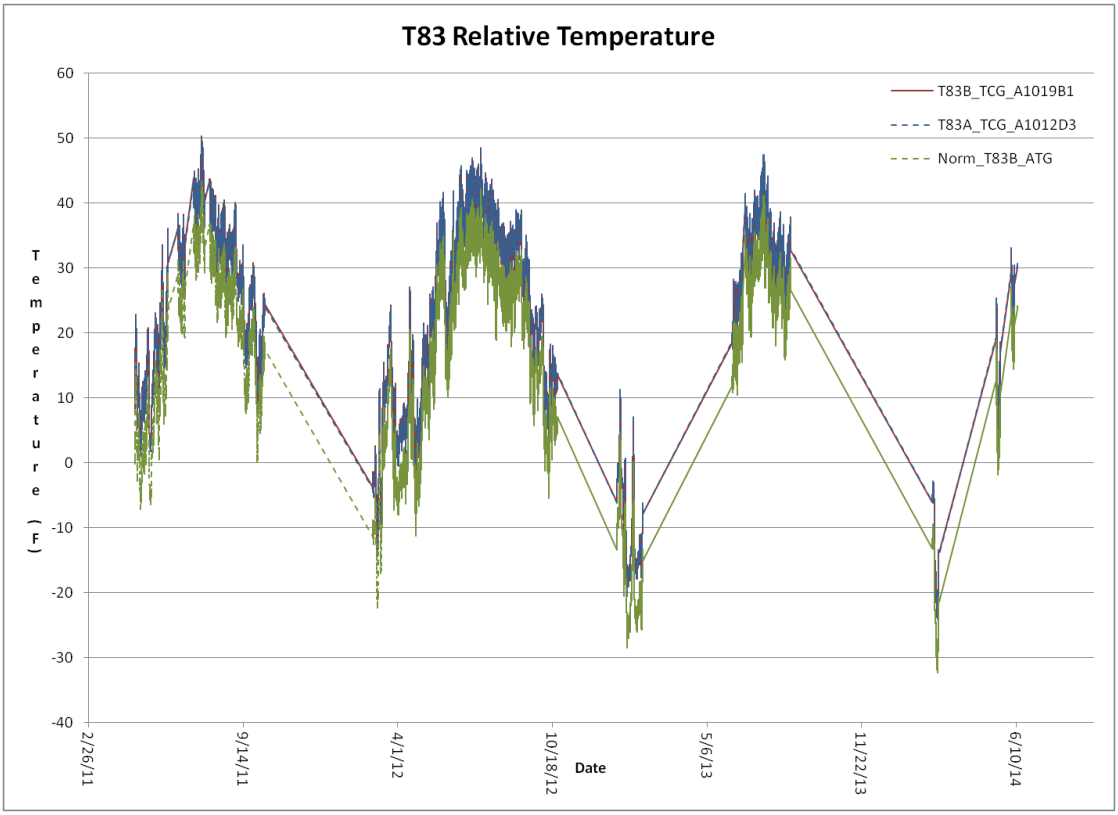

T67 Absolute Temperature
HRC_ATG
T67B_ATG_B313019
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

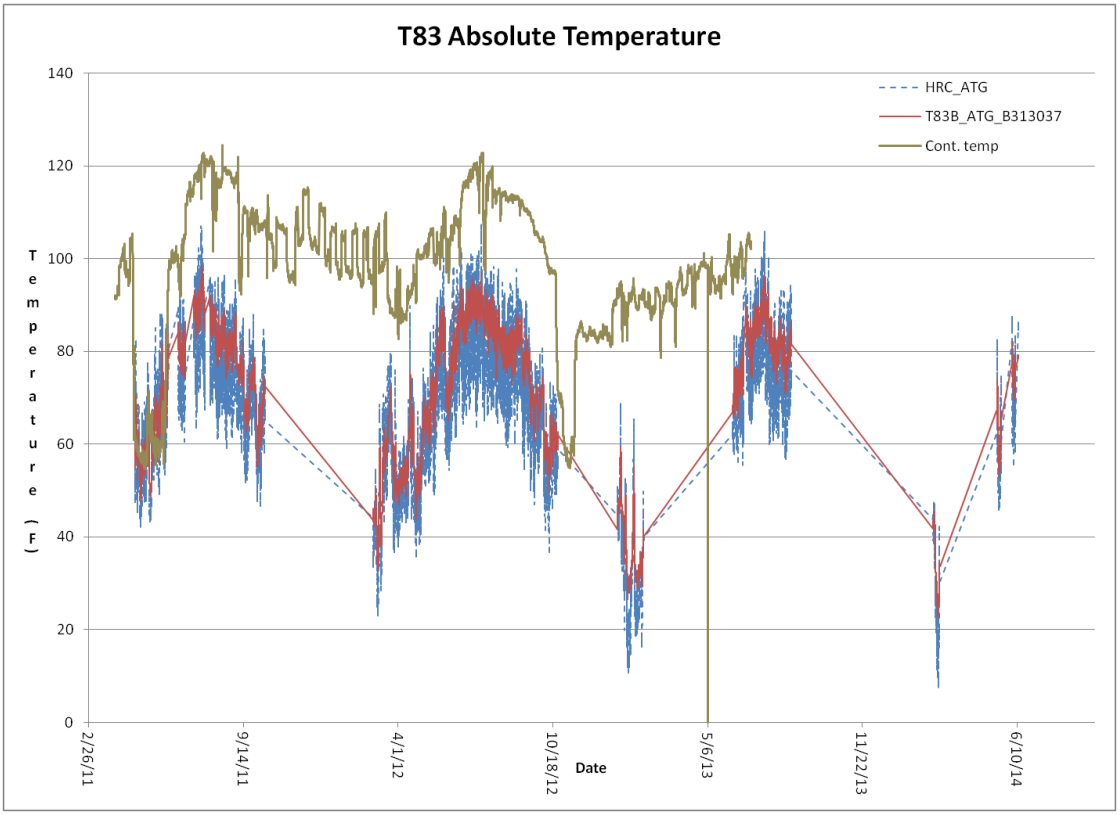
Tendon 83


T83
HRC_ATG
T83B_ATG_B313037
Cont temp
Cont Pres
T83A_TCG_A1012D3
T83B_TCG_A1019B1
T83
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-670
-680
-690
-700
-710
-720
-730
-740
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

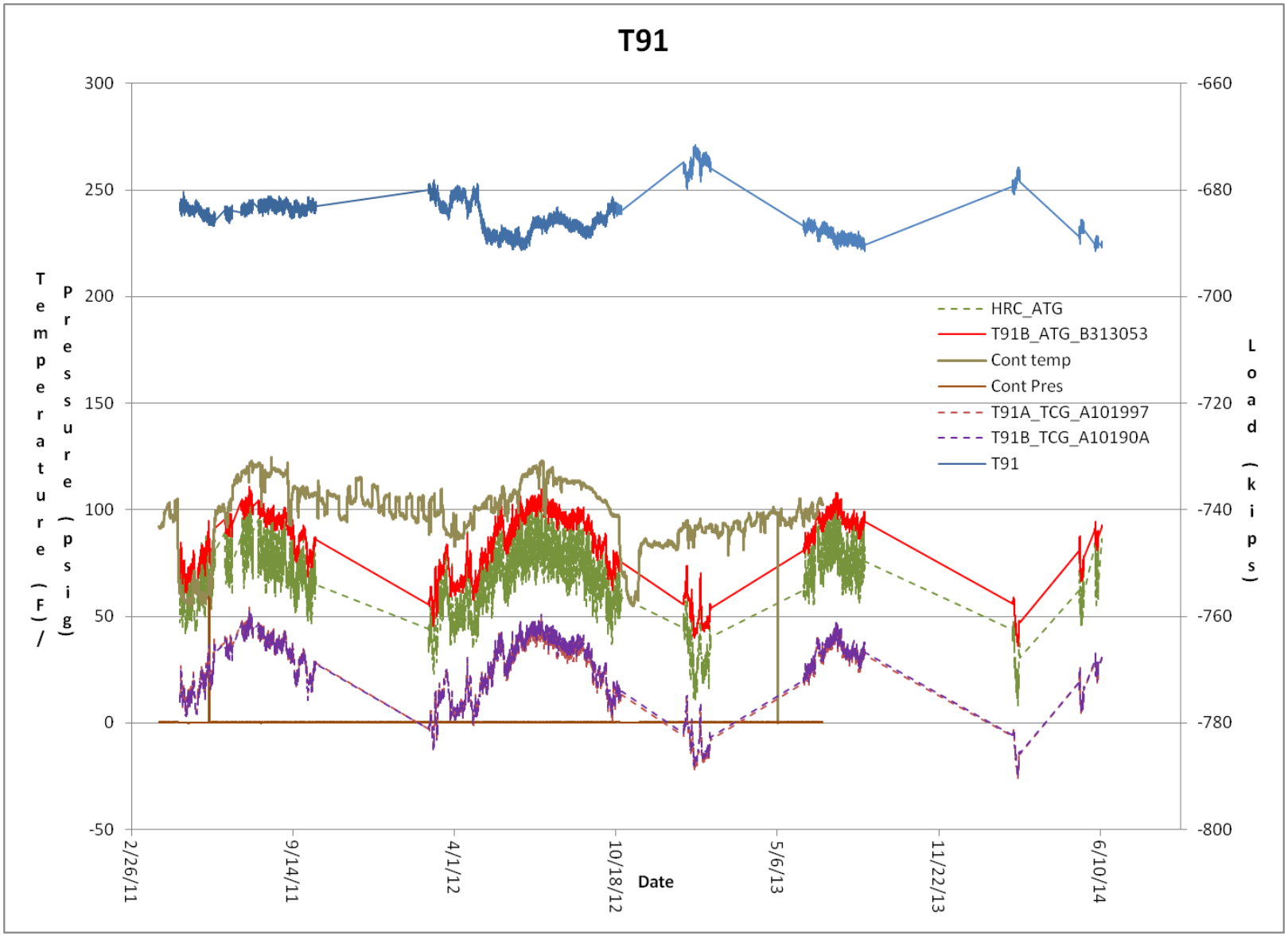

T83A and T83B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T83
T83A
T83B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

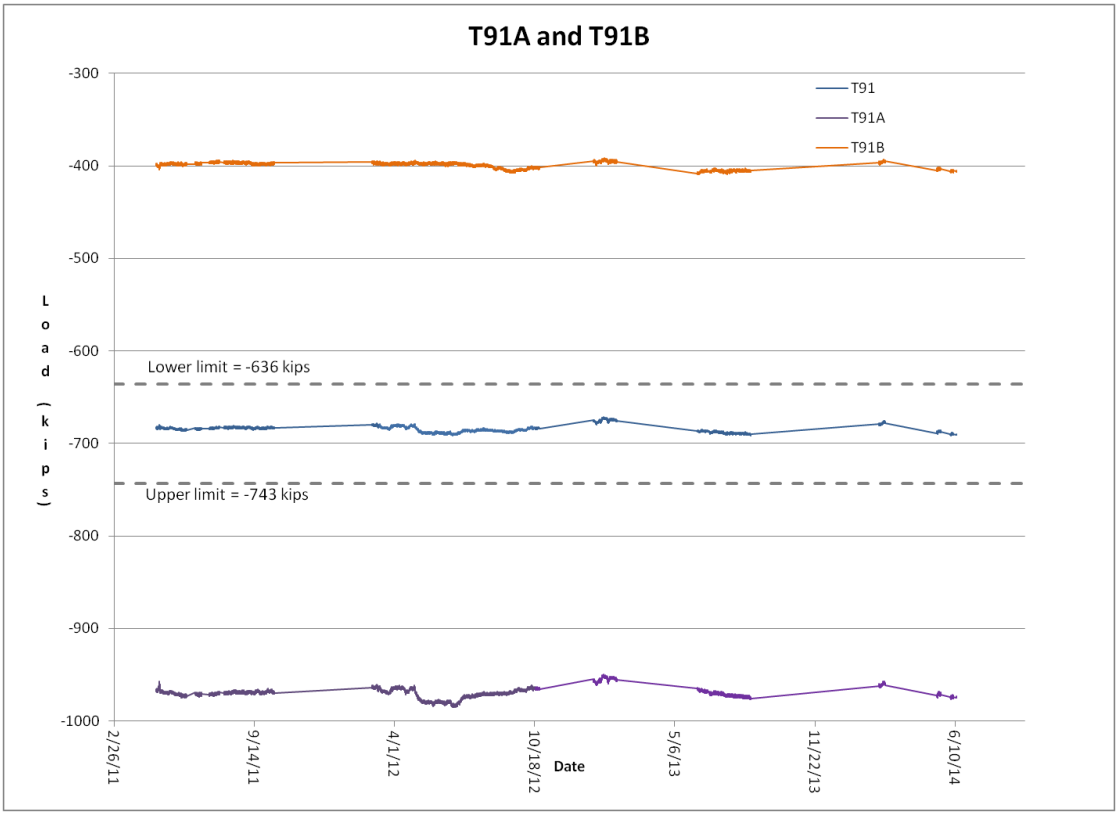

T83 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T83 norm
T83A norm
T83B norm
Initial tendon load (kips):
T83= -686
T83A= -650
T83B = -721
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

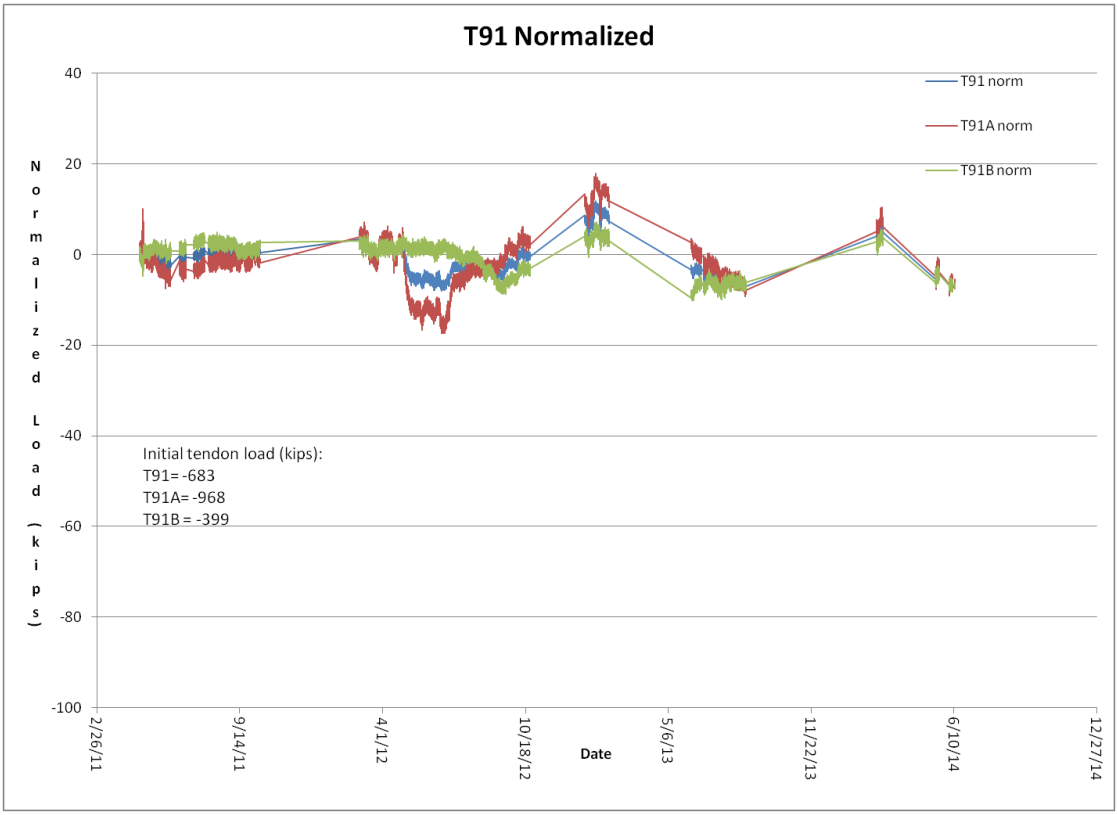

T83 Relative Temperature
T83B_TCG_A1019B1
T83A_TCG_A1012D3
Norm_T83B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

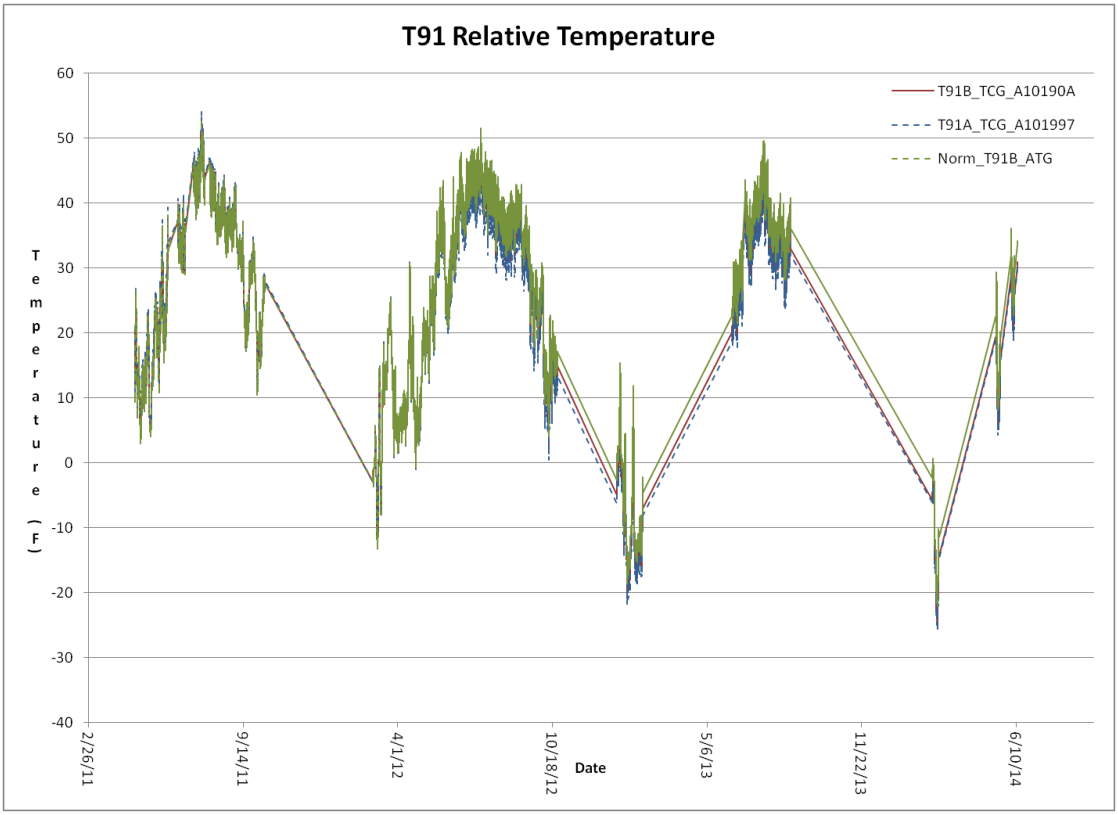

T83 Absolute Temperature
HRC_ATG
T83B_ATG_B313037
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

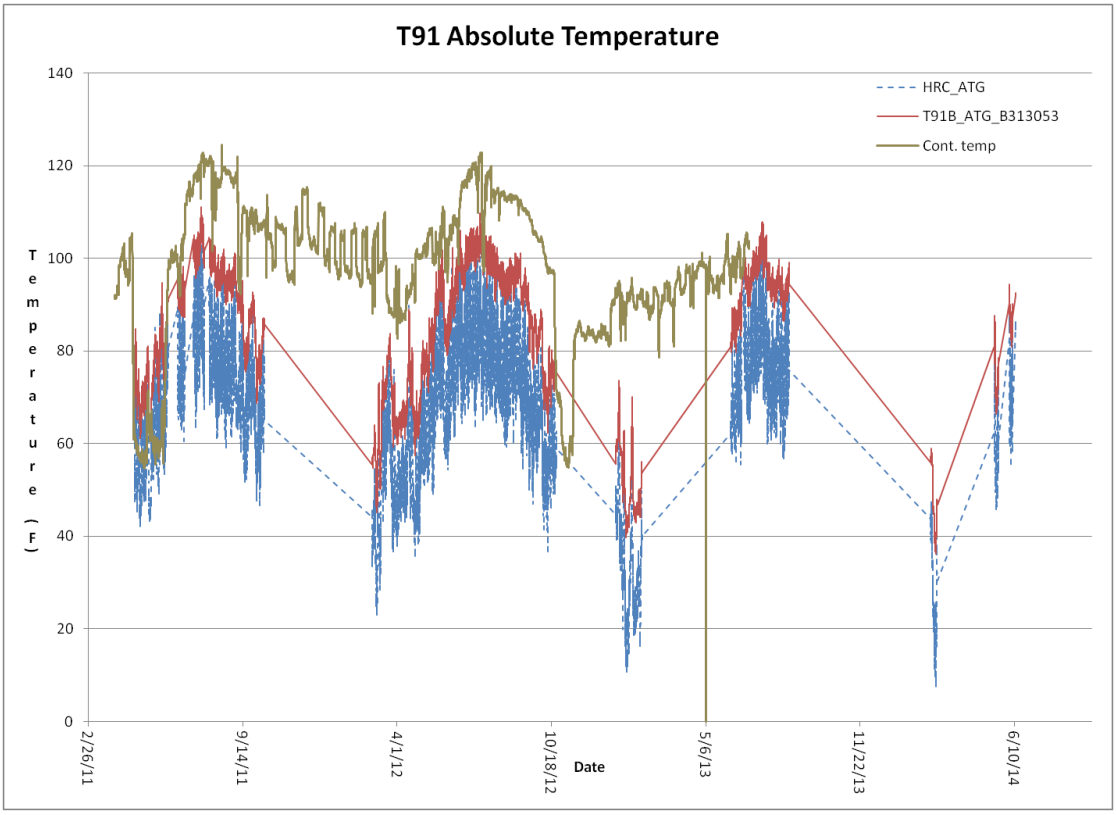
Tendon 91


T91
Temperature (F) / Pressure (psig)
Load (kips)
Date
300
250
200
150
100
50
0
-50
-660
-680
-700
-720
-740
-760
-780
-800
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
HRC_ATG
T91B_ATG_B313053
Cont temp
Cont Pres
T91A_TCG_A101997
T91B_TCG_A10190A
T91

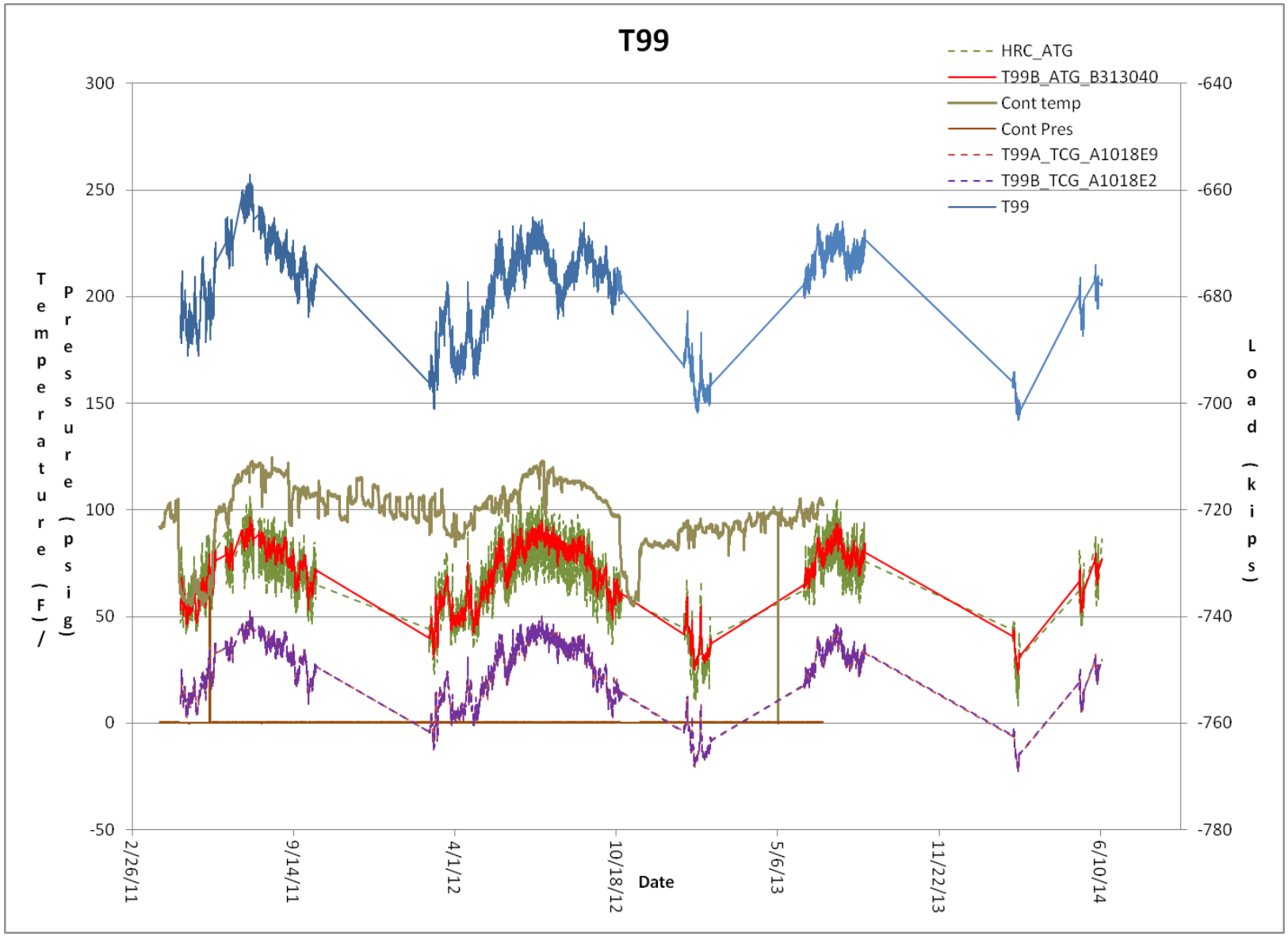

T91A and T91B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T91
T91A
T91B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

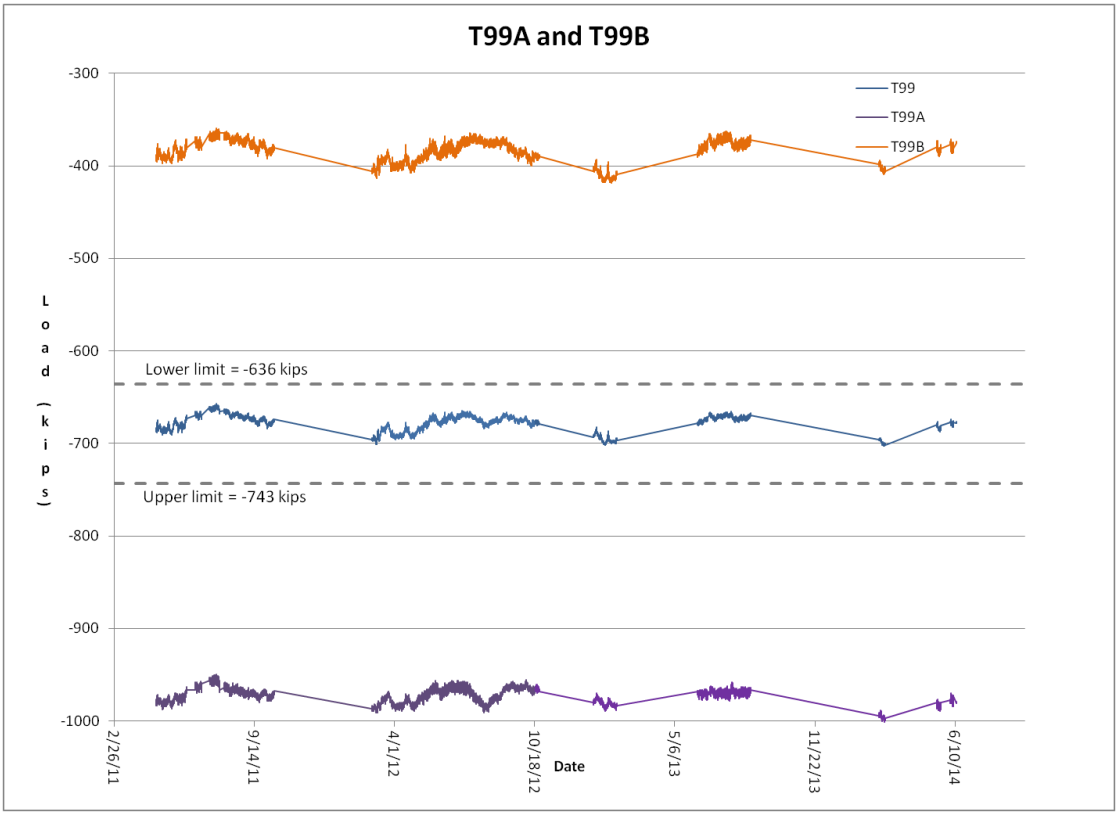

T91 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T91 norm
T91A norm
T91B norm
Initial tendon load (kips):
T91= -683
T91A= -968
T91B = -399
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

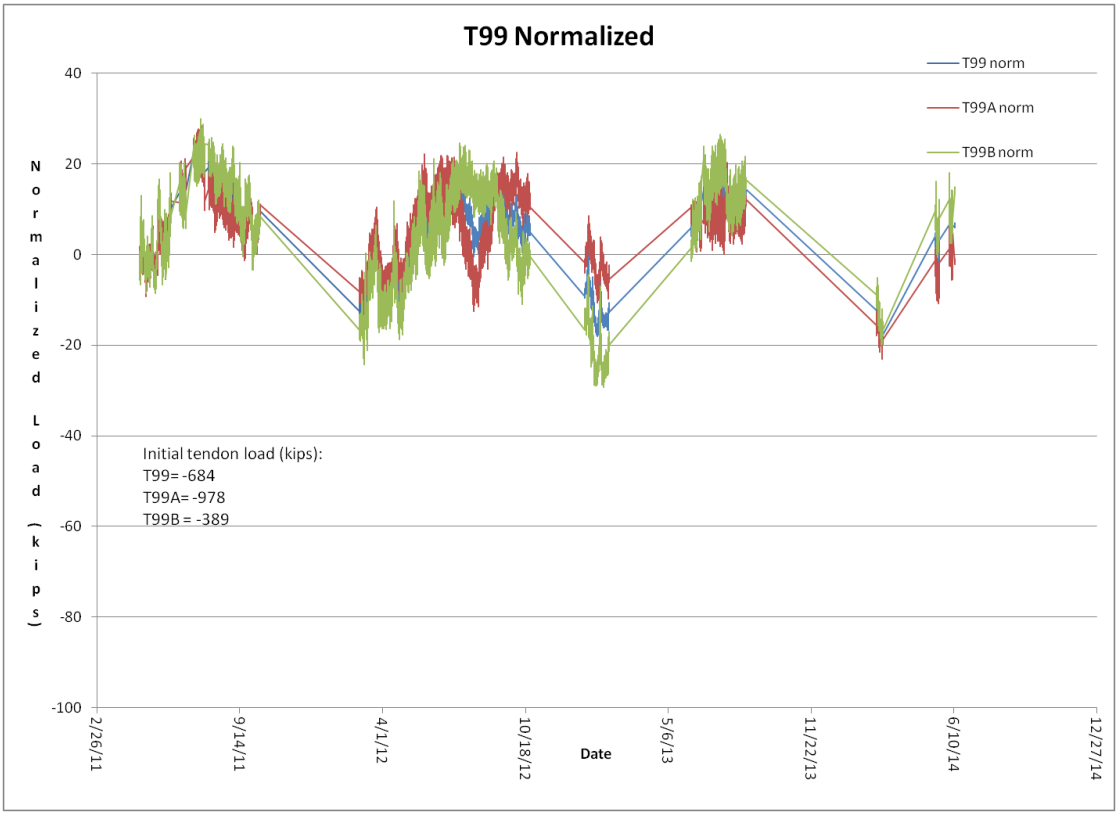

T91 Relative Temperature
T91B_TCG_A10190A
T91A_TCG_A101997
Norm_T91B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

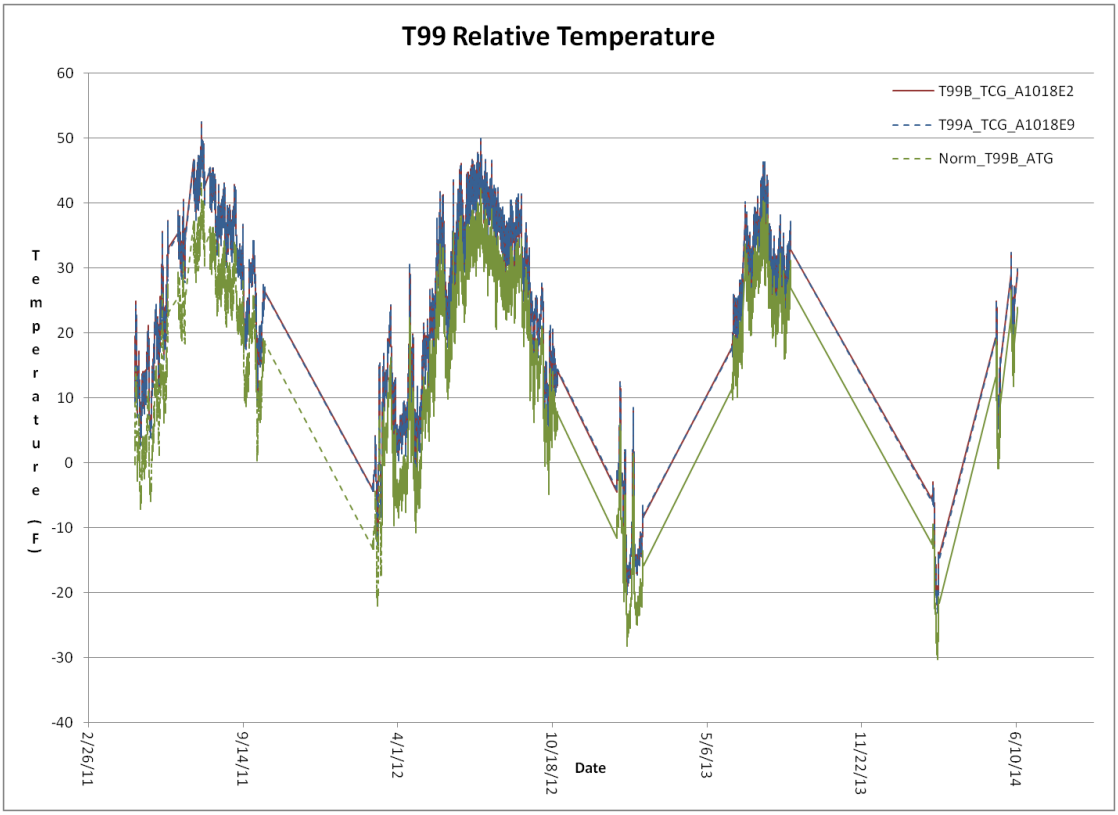

T91 Absolute Temperature
HRC_ATG
T91B_ATG_B313053
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

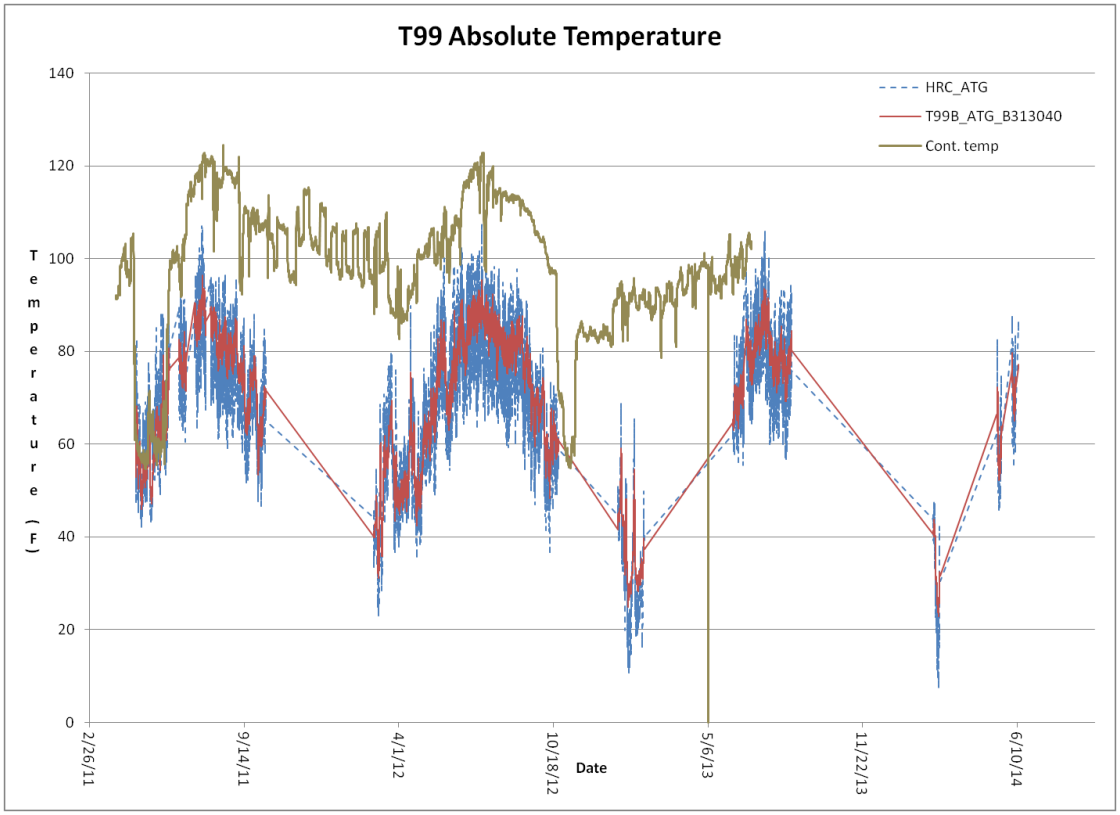
Tendon 99


T99
HRC_ATG
T99B_ATG_B313040
Cont temp
Cont Pres
T99A_TCG_A1018E9
T99B_TCG_A1018E2
T99
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-640
-660
-680
-700
-720
-740
-760
-780
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

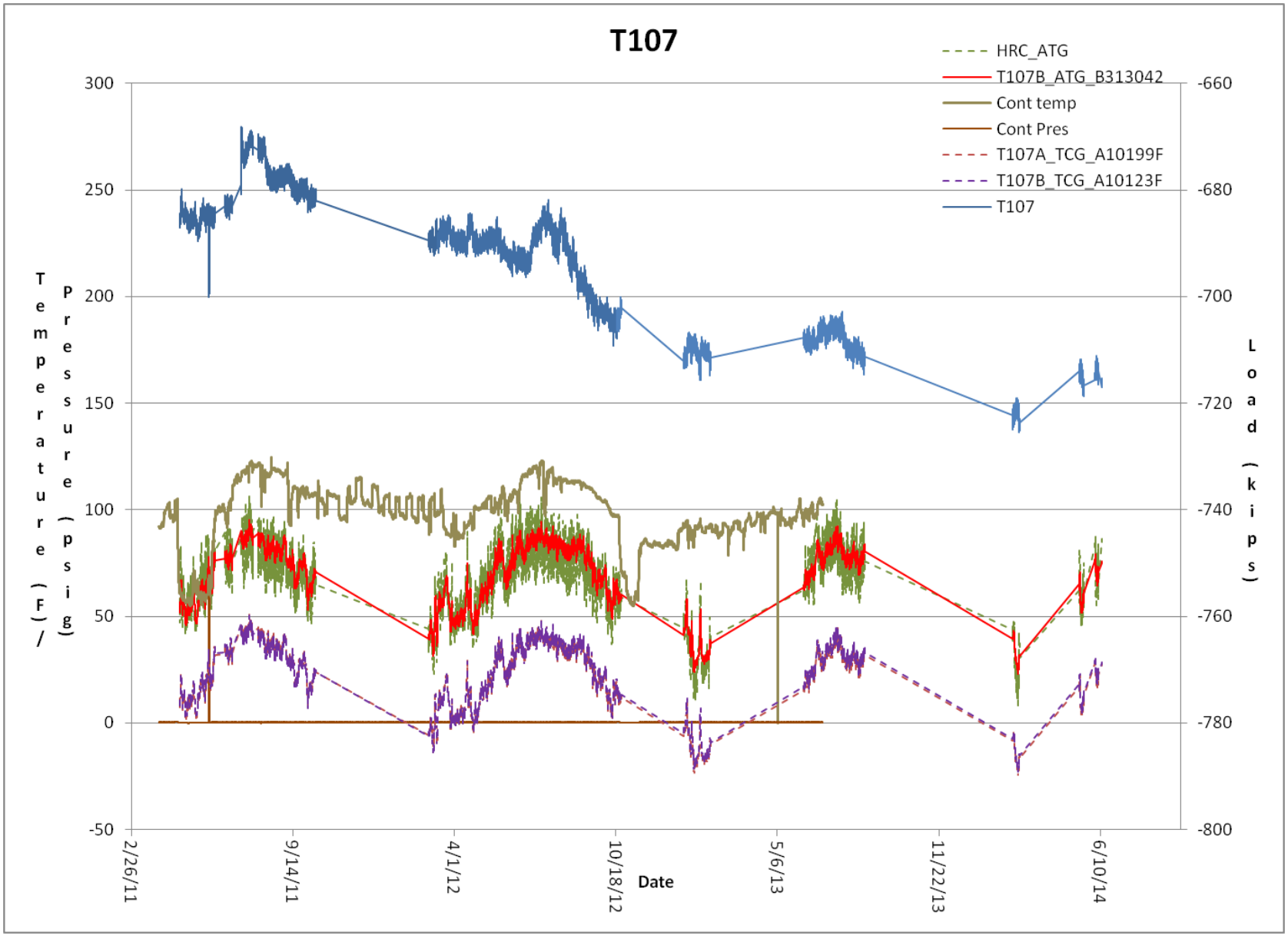

T99A and T99B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T99
T99A
T99B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

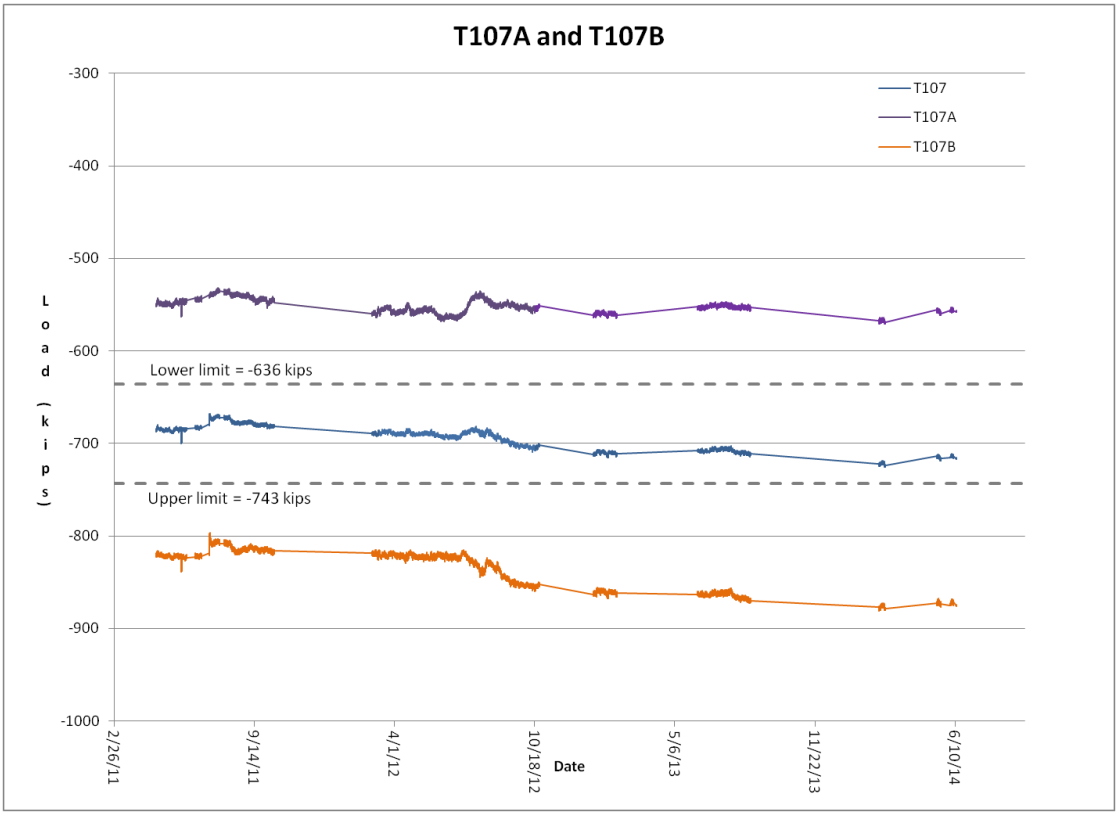

T99 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T99 norm
T99A norm
T99B norm
Initial tendon load (kips):
T99= -684
T99A= -978
T99B = -389
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

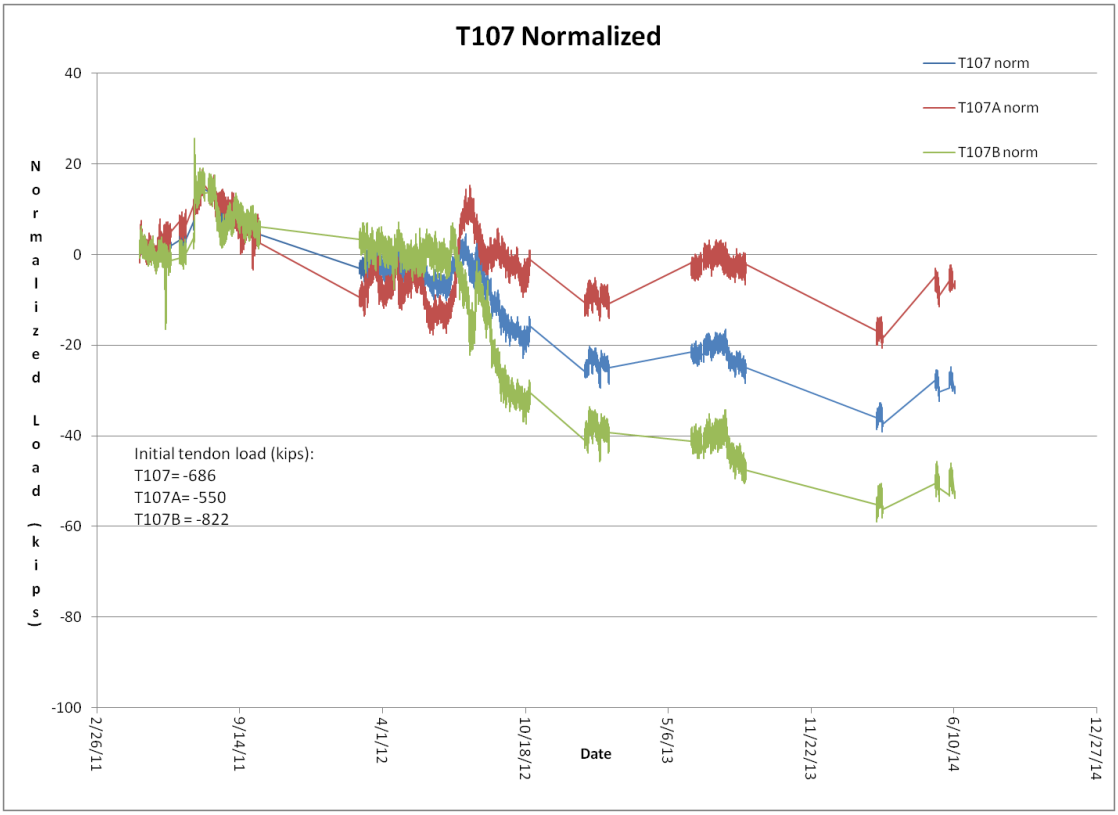

T99 Relative Temperature
T99B_TCG_A1018E2
T99A_TCG_A1018E9
Norm_T99B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

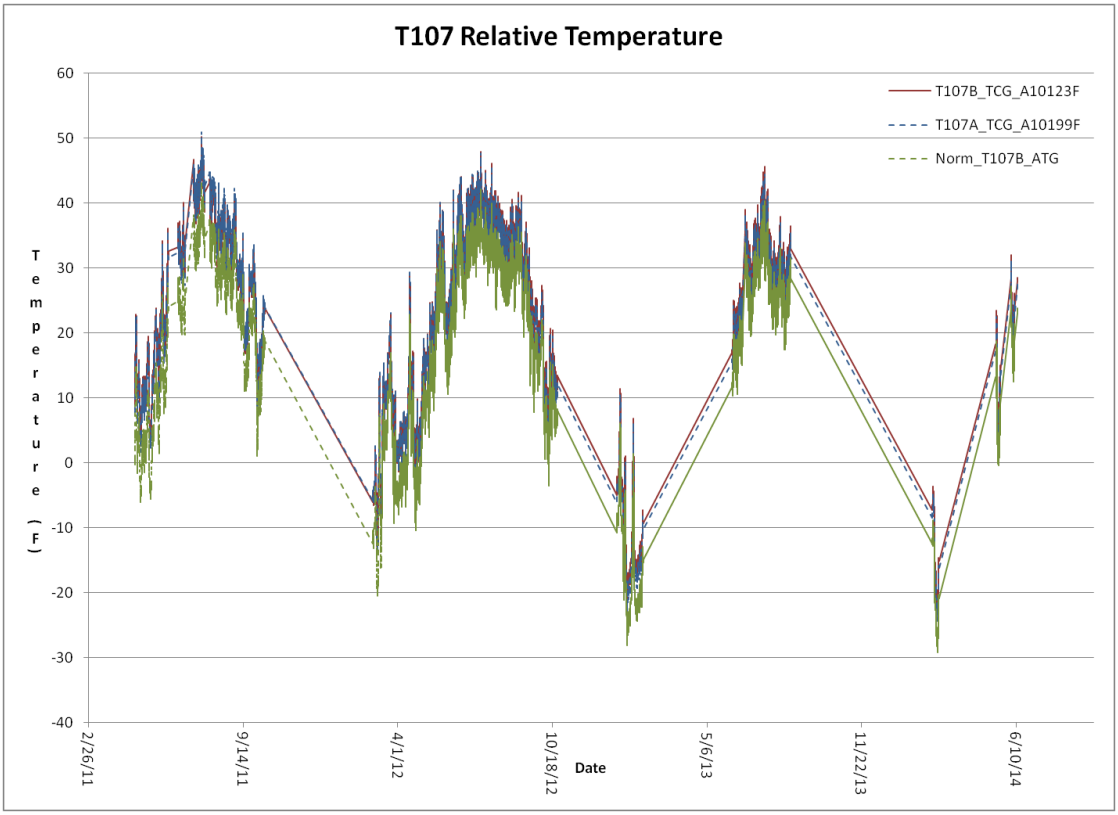

T99 Absolute Temperature
HRC_ATG
T99B_ATG_B313040
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

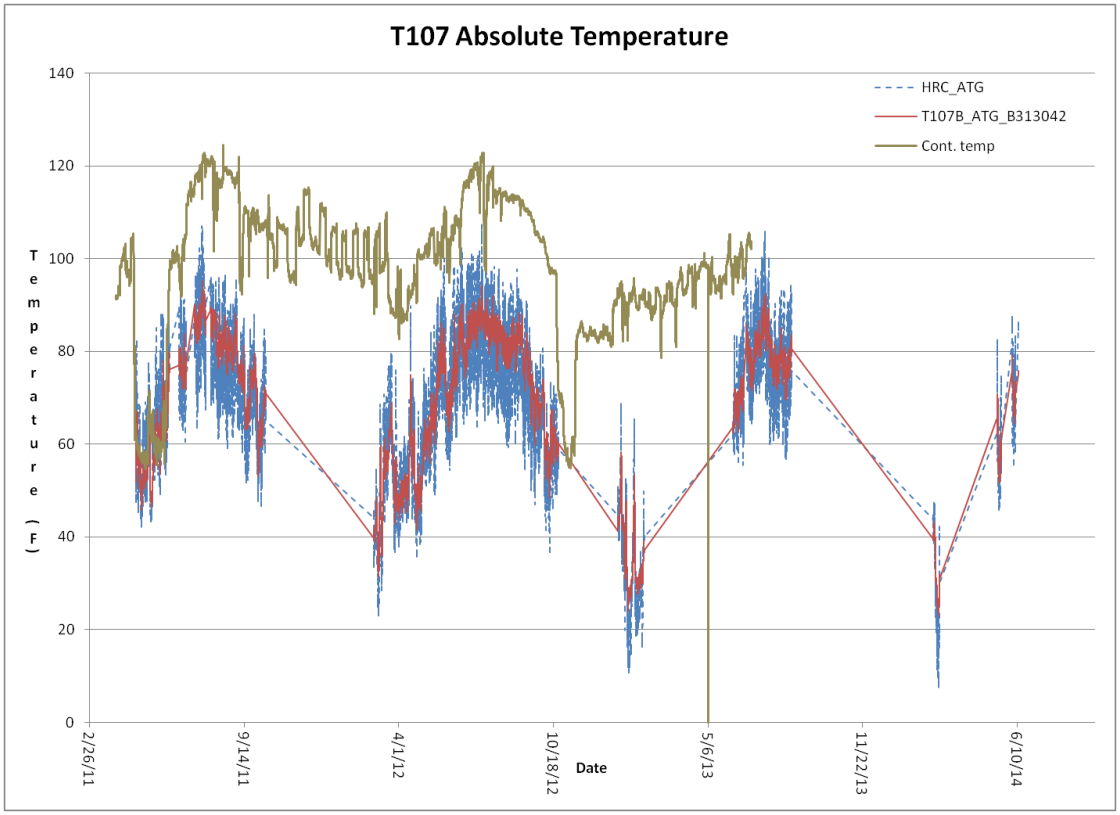
Tendon 107


T107
HRC_ATG
T107B_ATG_B313042
Cont temp
Cont Pres
T107A_TCG_A10199F
T107B_TCG_A10123F
T107
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-660
-680
-700
-720
-740
-760
-780
-800
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

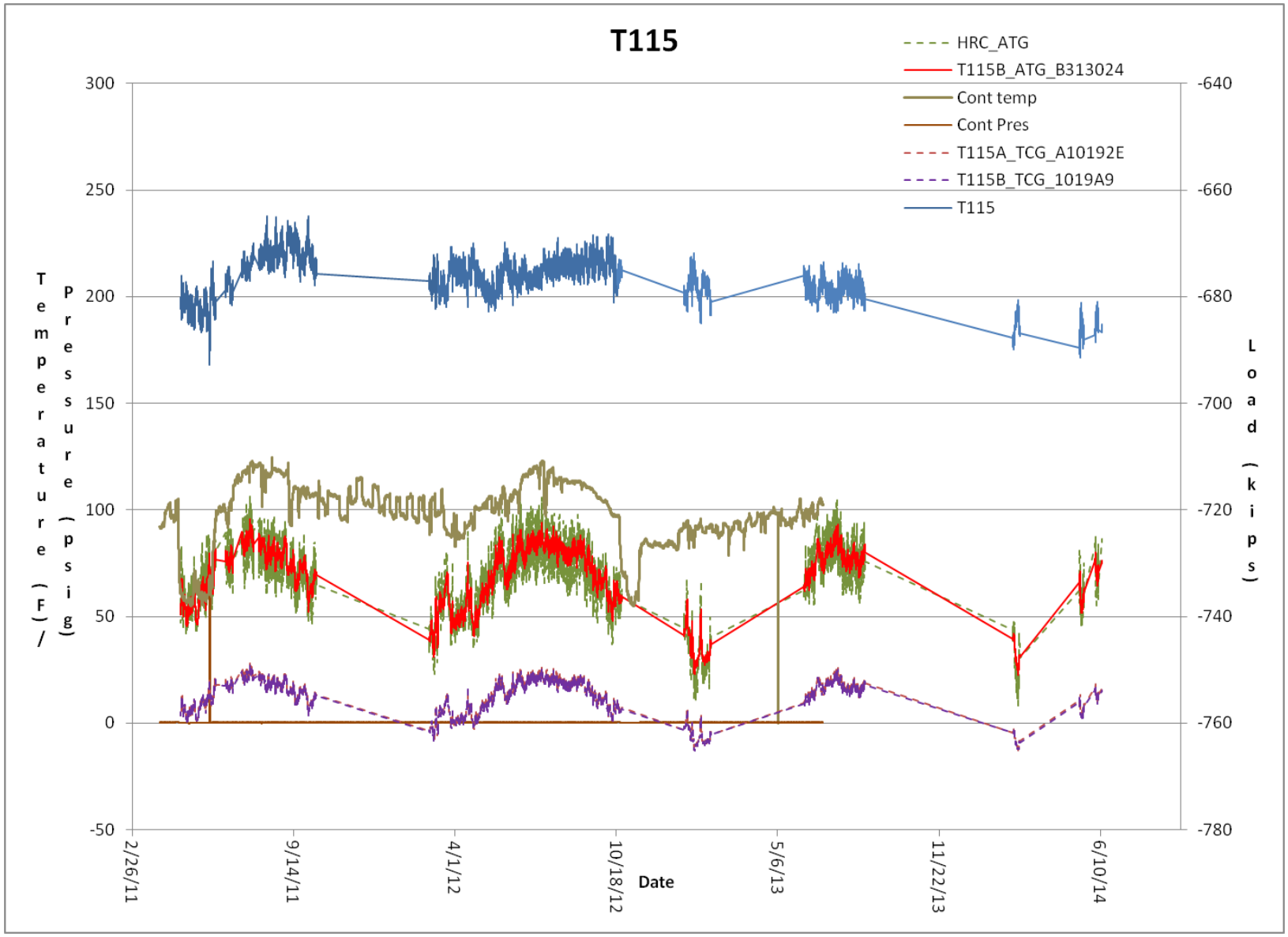

T107A and T107B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T107
T107A
T107B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

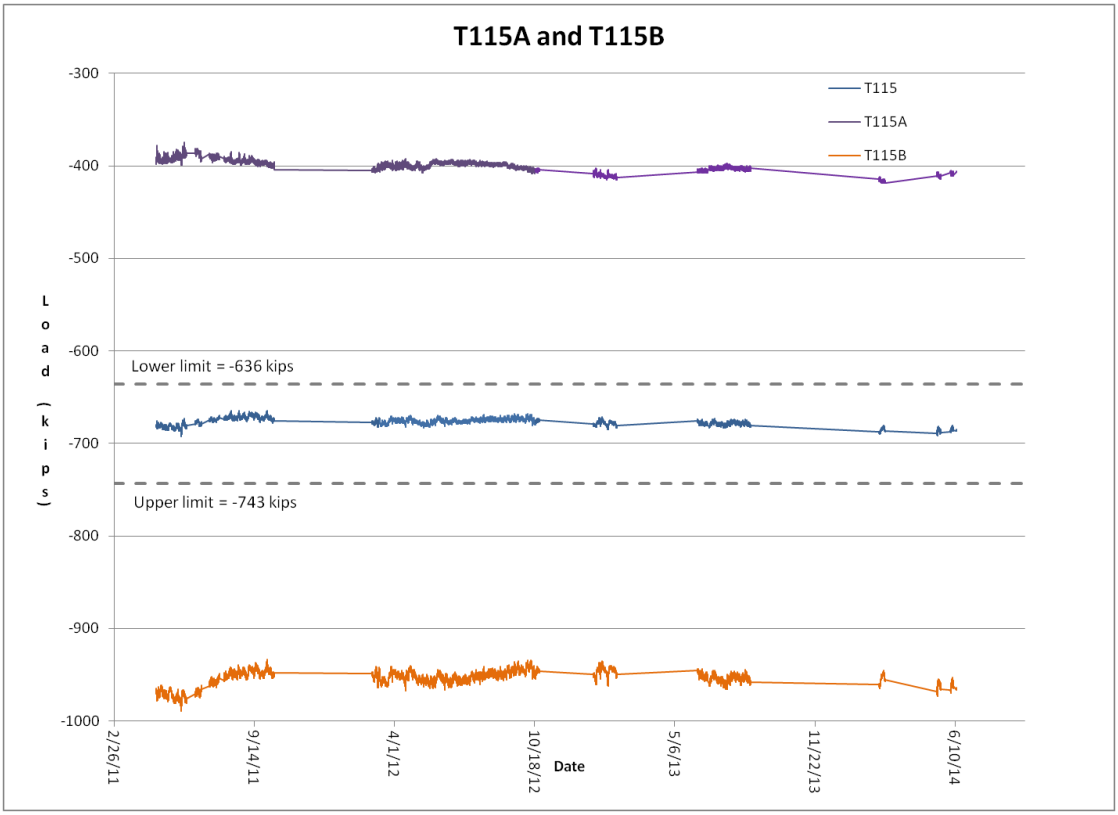

T107 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T107 norm
T107A norm
T107B norm
Initial tendon load (kips):
T107= -686
T107A= -550
T107B = -822
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

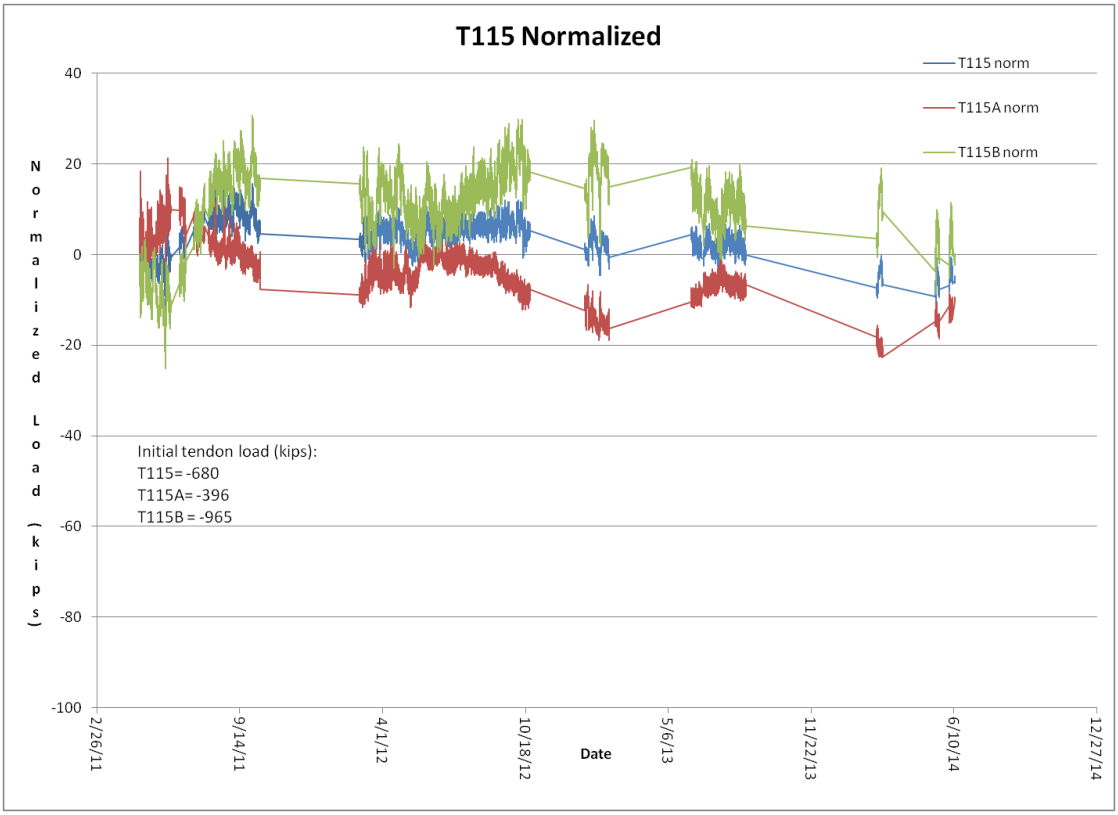

T107 Relative Temperature
T107B_TCG_A10123F
T107A_TCG_A10199F
Norm_T107B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

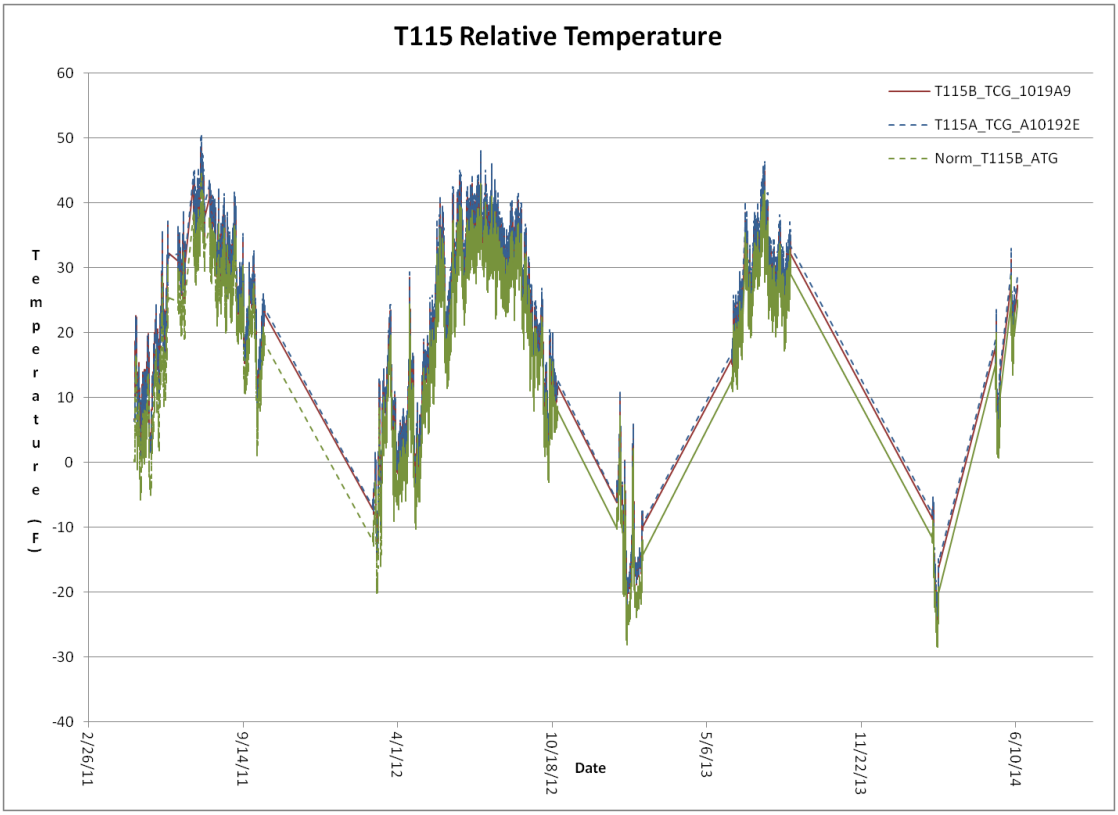

T107 Absolute Temperature
HRC_ATG
T107B_ATG_B313042
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

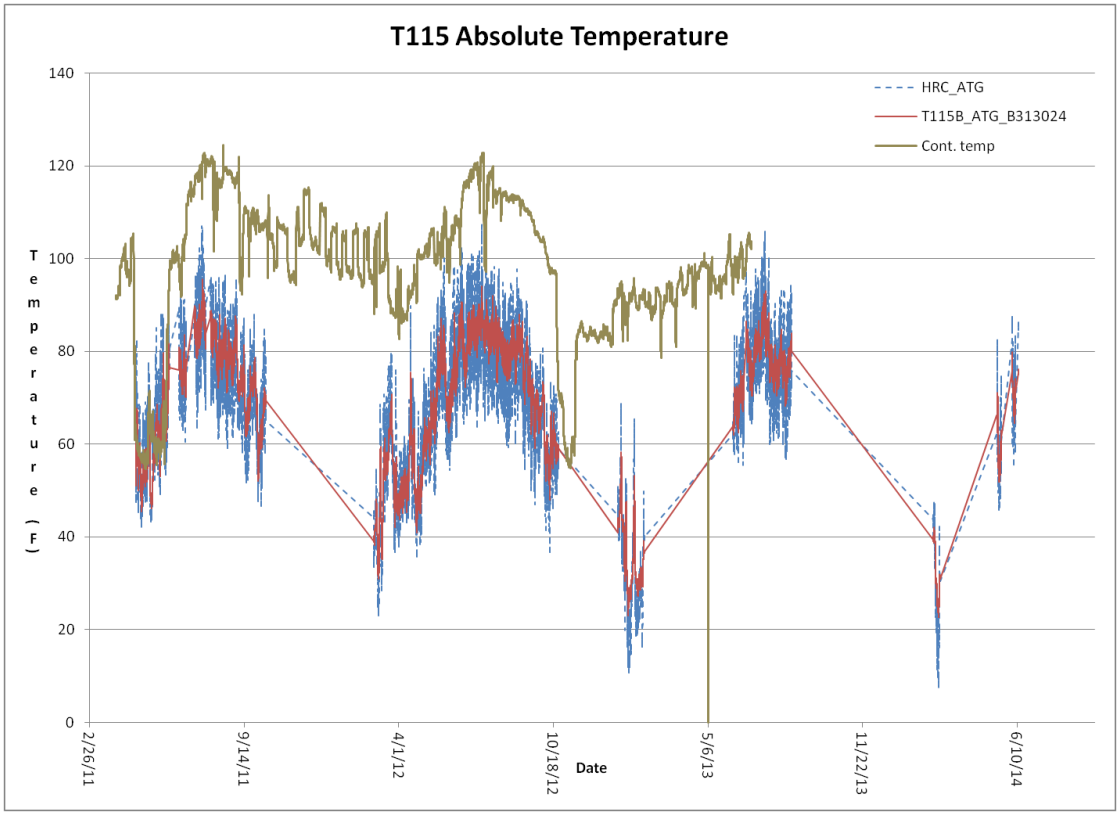
Tendon 115


T115
HRC_ATG
T115B_ATG_B313024
Cont temp
Cont Pres
T115A_TCG_A10192E
T115B_TCG_1019A9
T115
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-640
-660
-680
-700
-720
-740
-760
-780
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

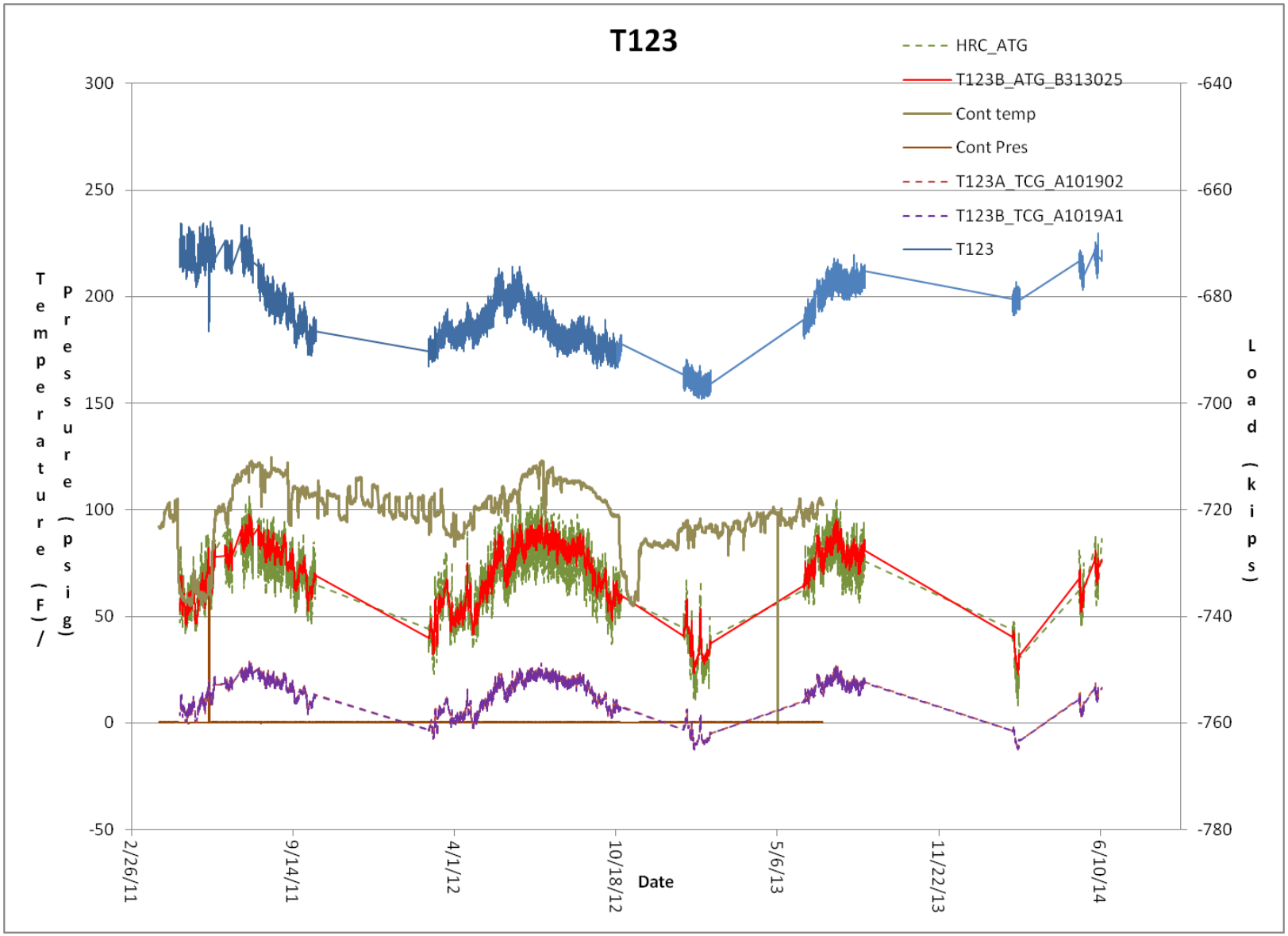

T115A and T115B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T115
T115A
T115B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

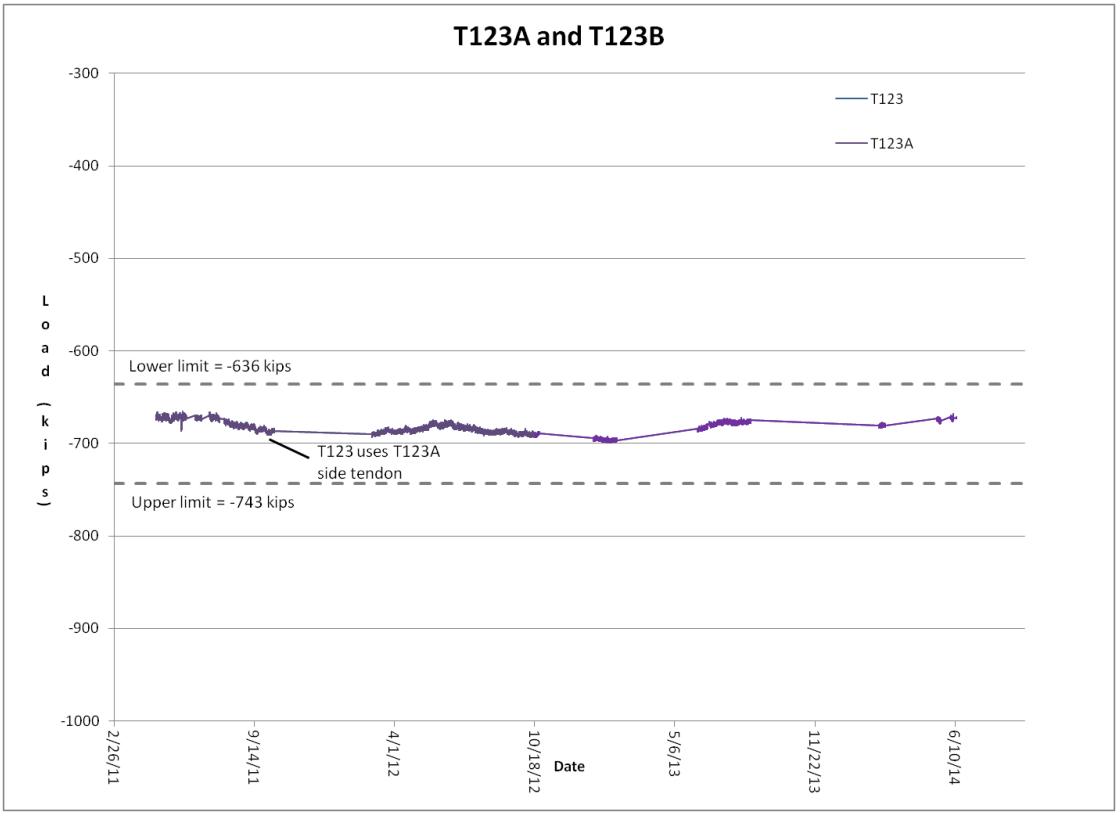

T115 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T115 norm
T115A norm
T115B norm
Initial tendon load (kips):
T115= -680
T115A= -396
T115B = -965
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

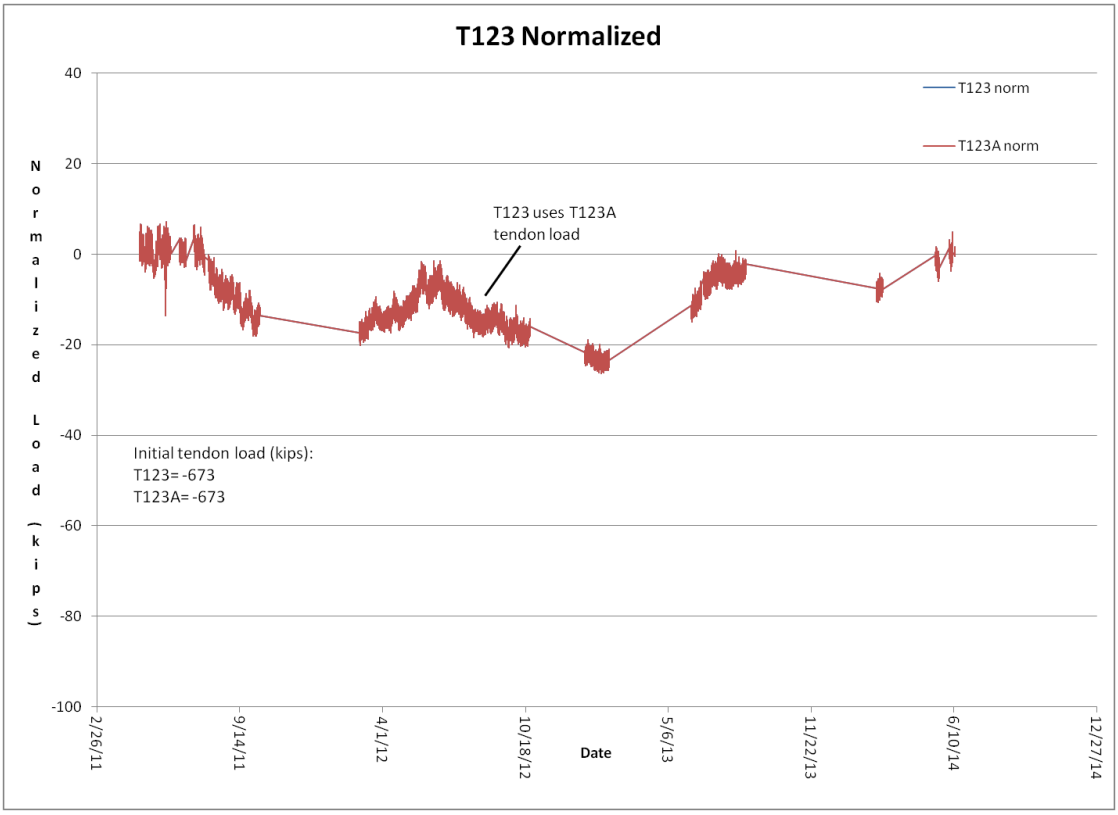

T115 Relative Temperature
T115B_TCG_1019A9
T115A_TCG_A10192E
Norm_T115B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

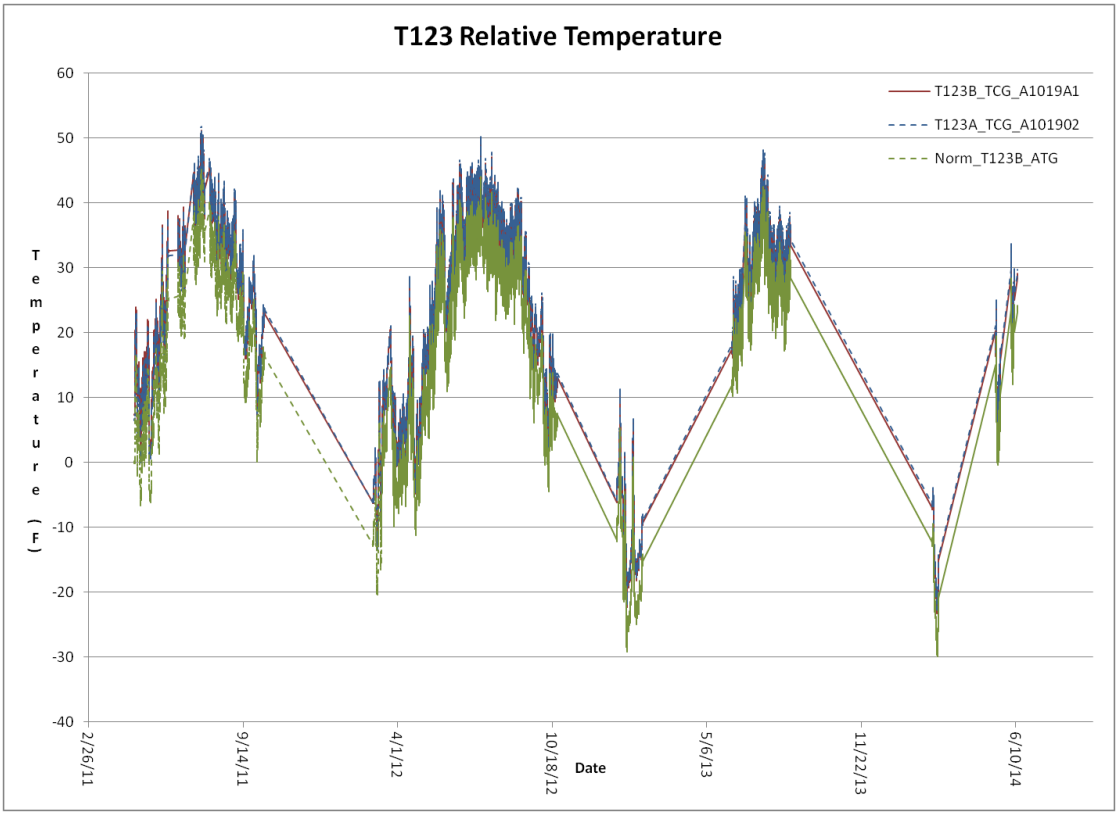

T115 Absolute Temperature
HRC_ATG
T115B_ATG_B313024
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

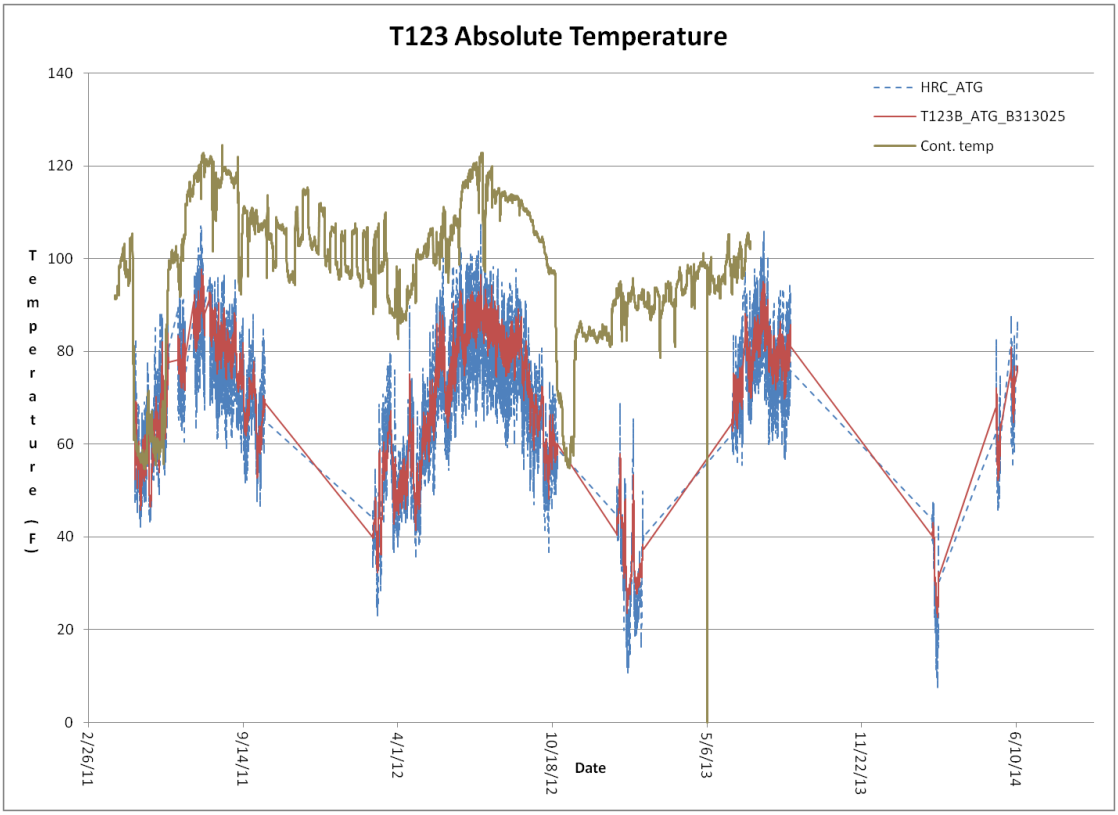
Tendon 123


T123
HRC_ATG
T123B_ATG_B313025
Cont temp
Cont Pres
T123A_TCG_A101902
T123B_TCG_A1019A1
T123
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-640
-660
-680
-700
-720
-740
-760
-780
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

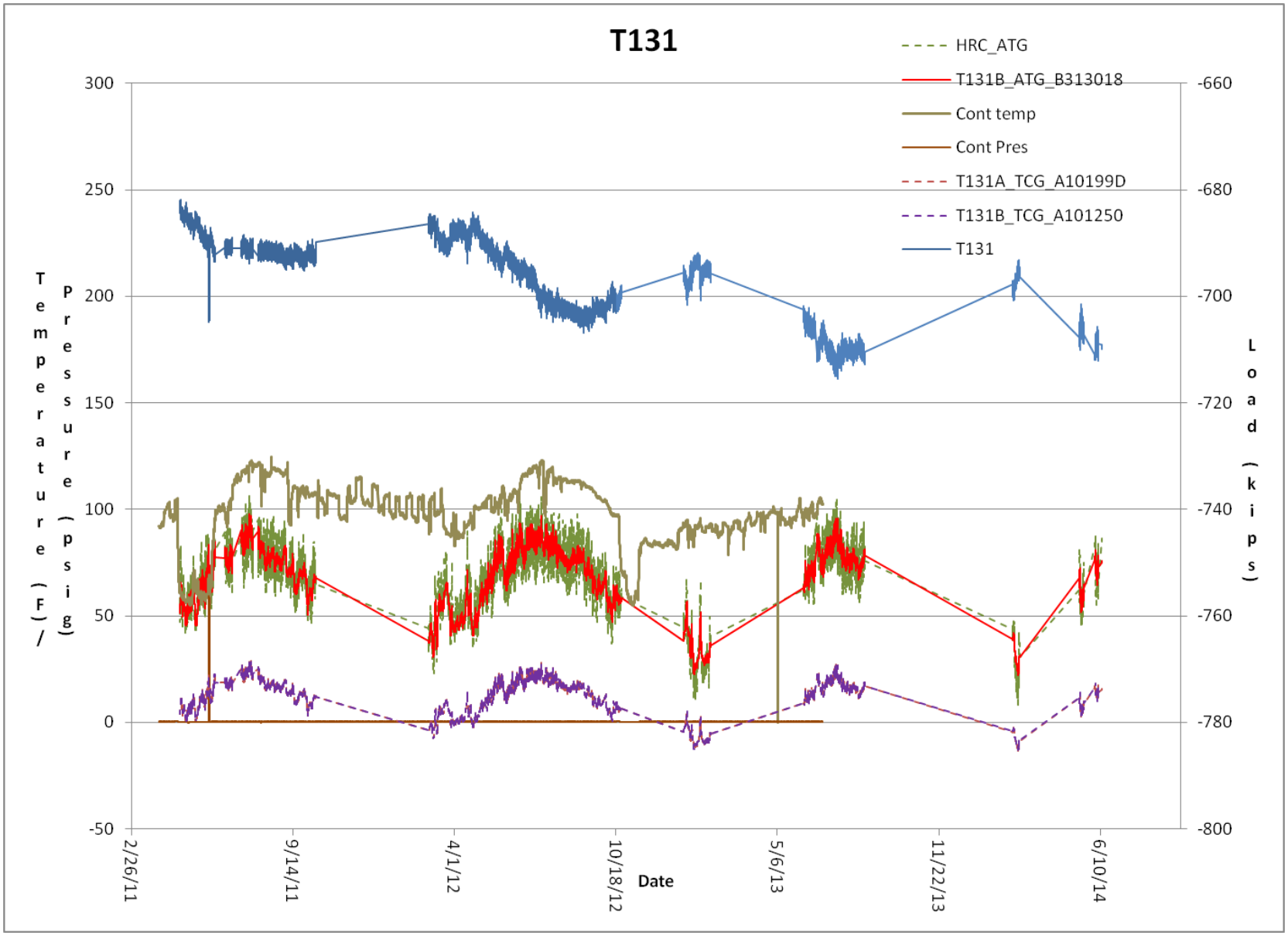

T123A and T123B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T123
T123A
Lower limit = -636 kips
T123 uses T123A
side tendon
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

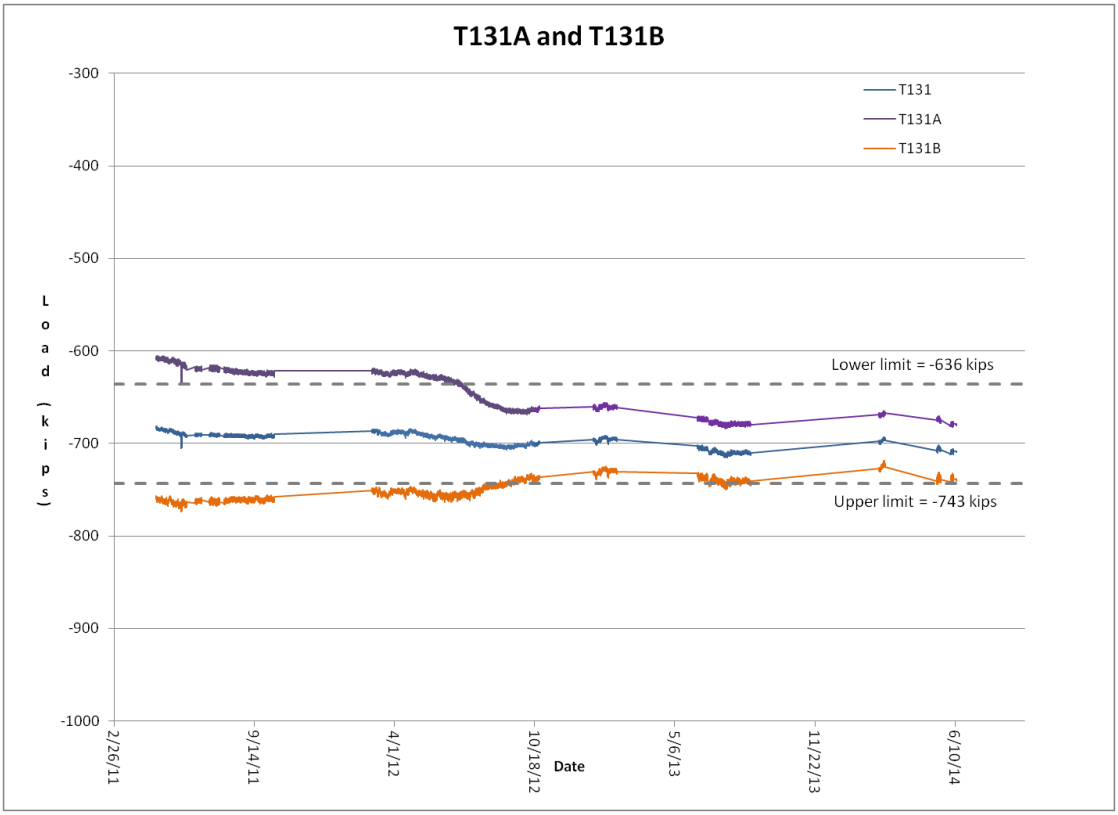

T123 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T123 norm
T123A norm
T123 uses T123A
tendon load
Initial tendon load (kips):
T123= -673
T123A= -673
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

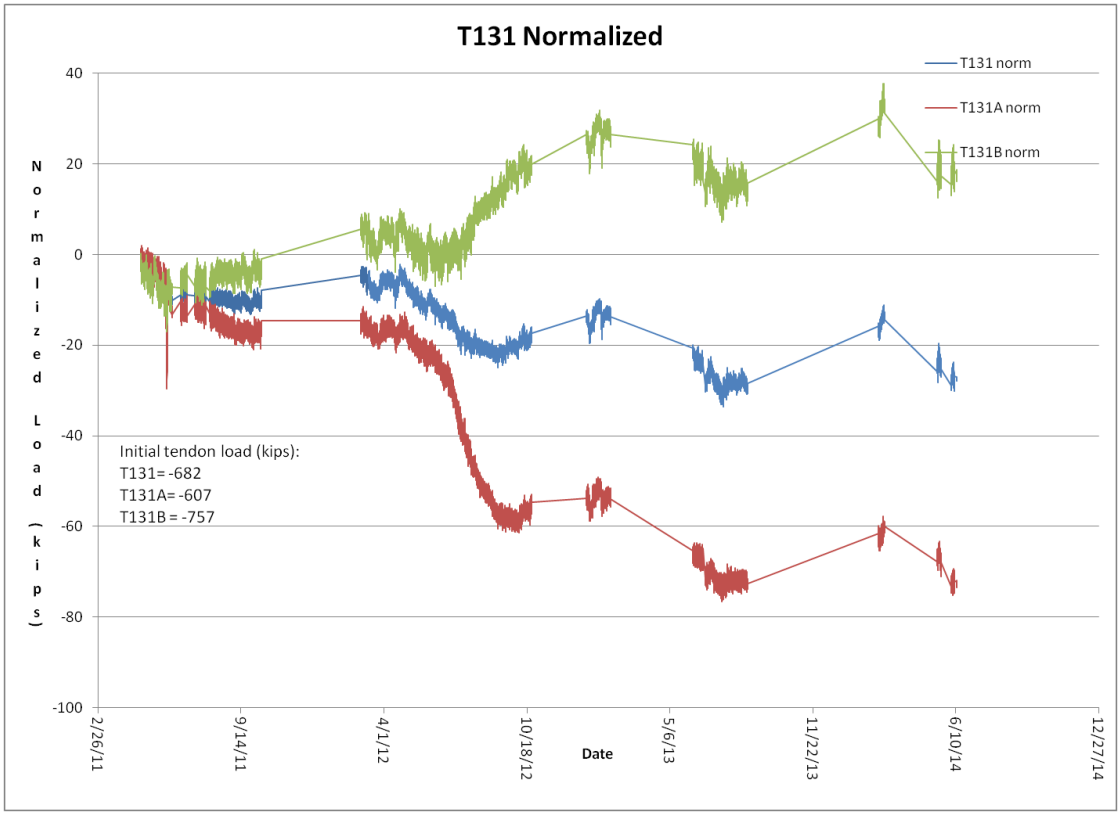

T123 Relative Temperature
T123B_TCG_A1019A1
T123A_TCG_A101902
Norm_T123B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

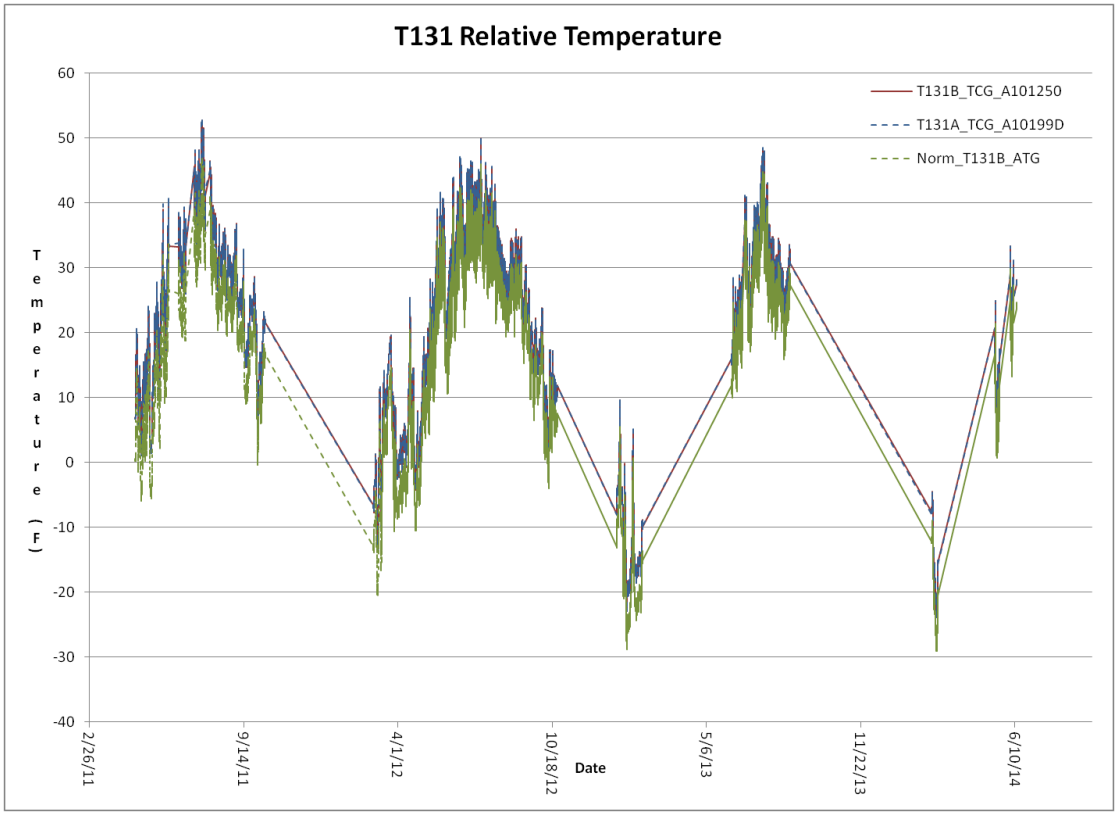

T123 Absolute Temperature
HRC_ATG
T123B_ATG_B313025
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

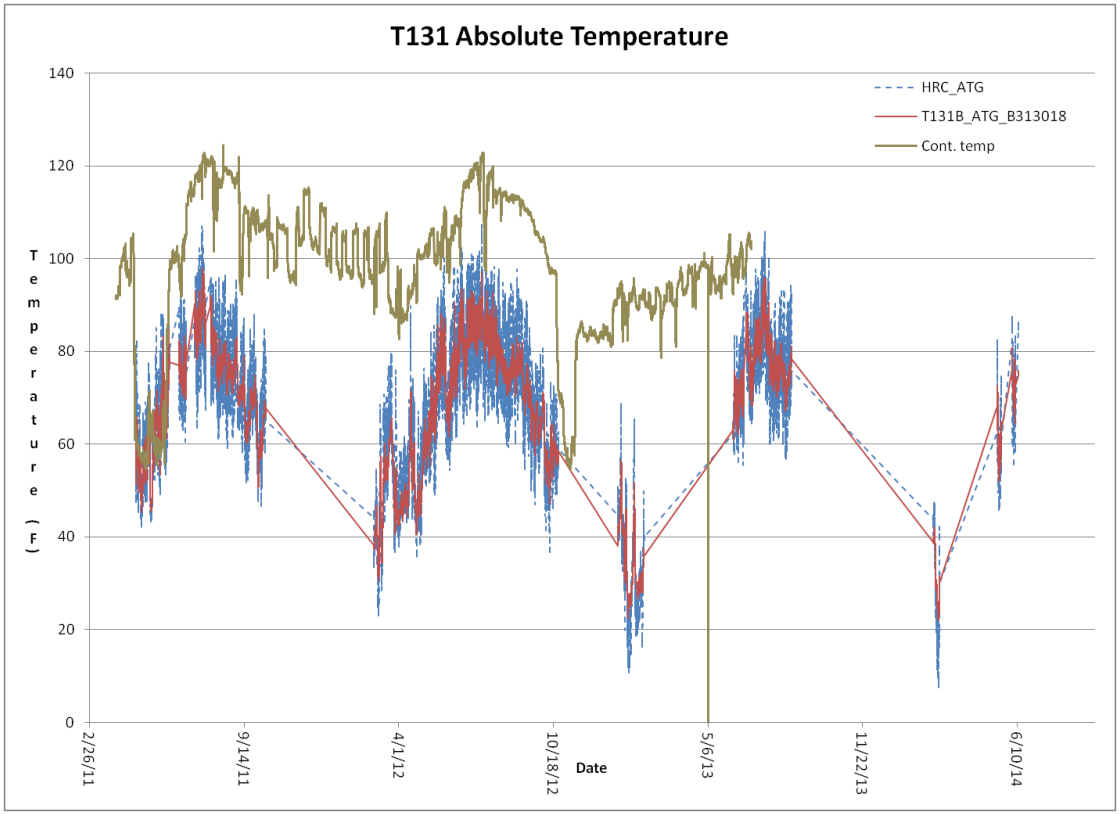
Tendon 131


T131
HRC_ATG
T131B_ATG_B313018
Cont temp
Cont Pres
T131A_TCG_A10199D
T131B_TCG_A101250
T131
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-660
-680
-700
-720
-740
-760
-780
-800
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

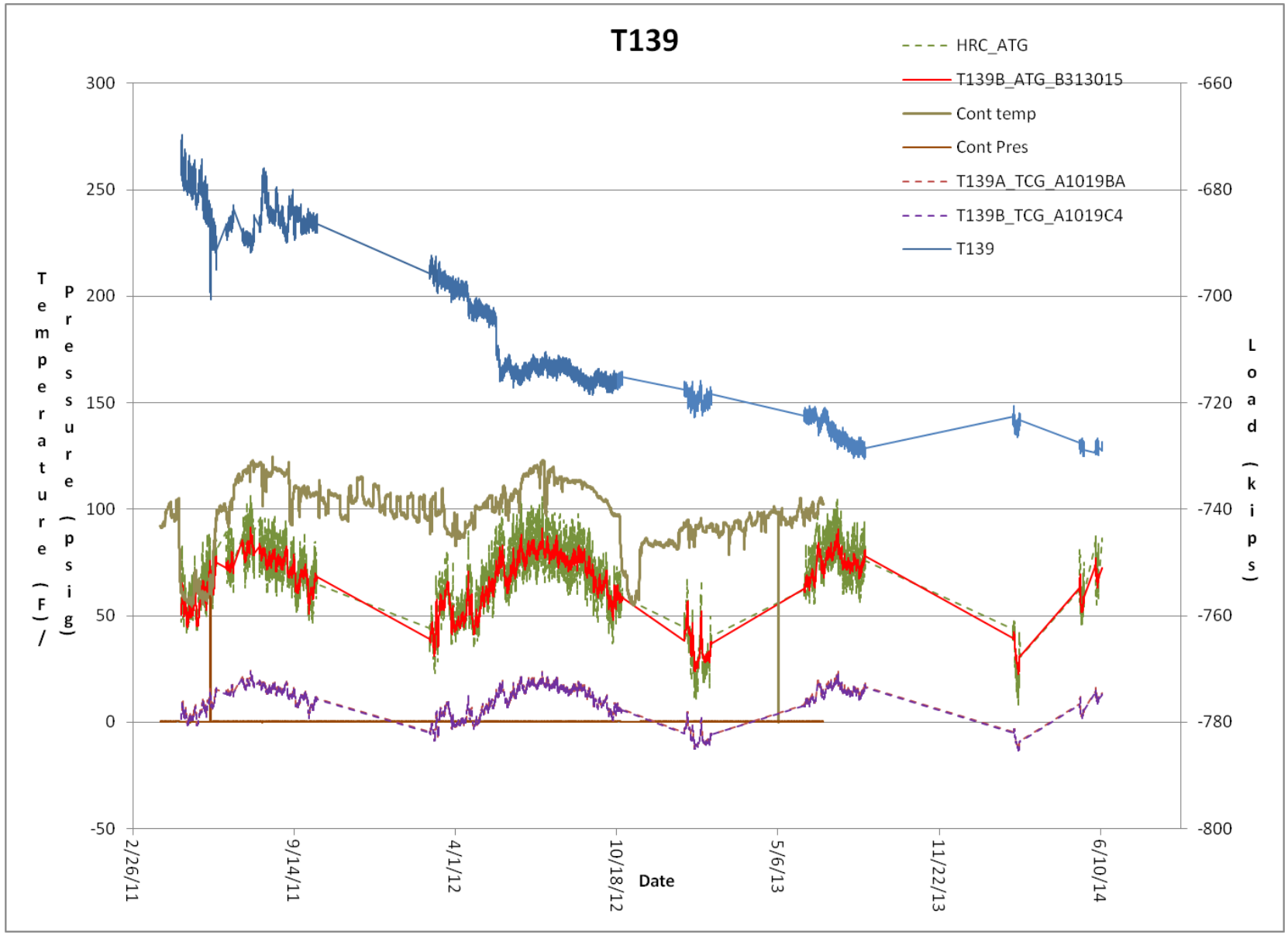

T131A and T131B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T131
T131A
T131B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

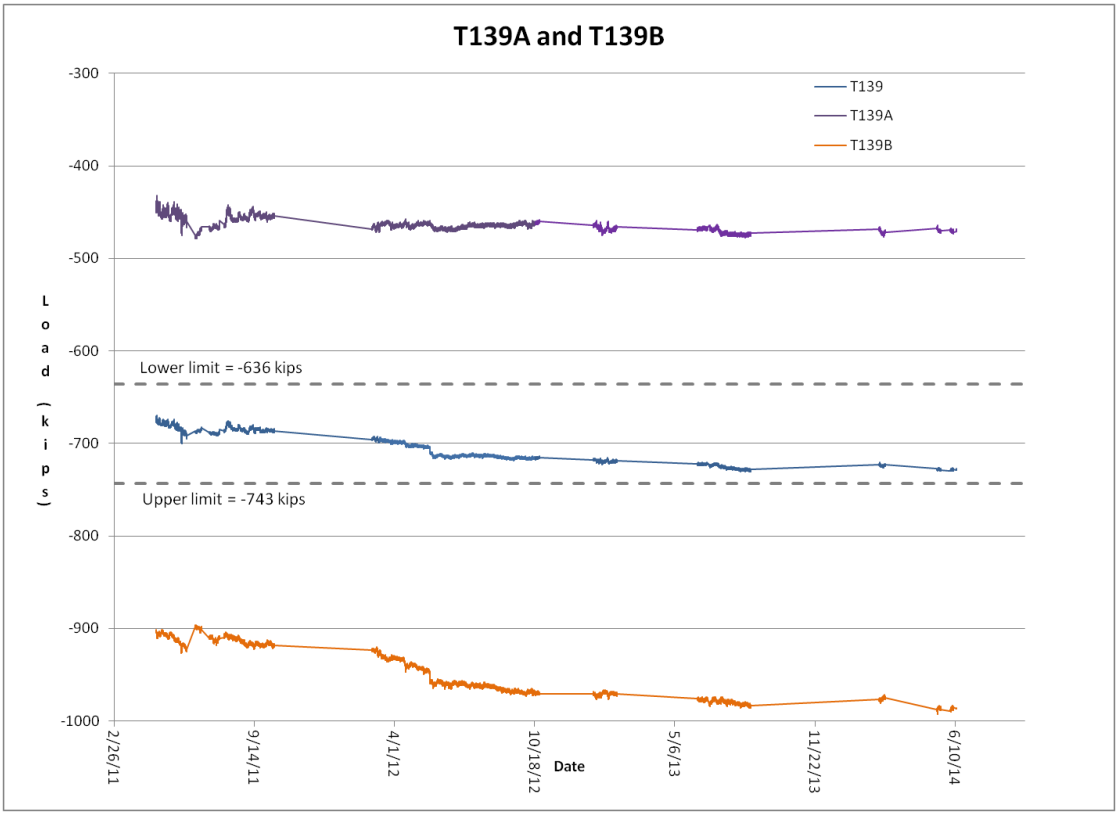

T131 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T131 norm
T131A norm
T131B norm
Initial tendon load (kips):
T131= -682
T131A= -607
T131B = -757
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

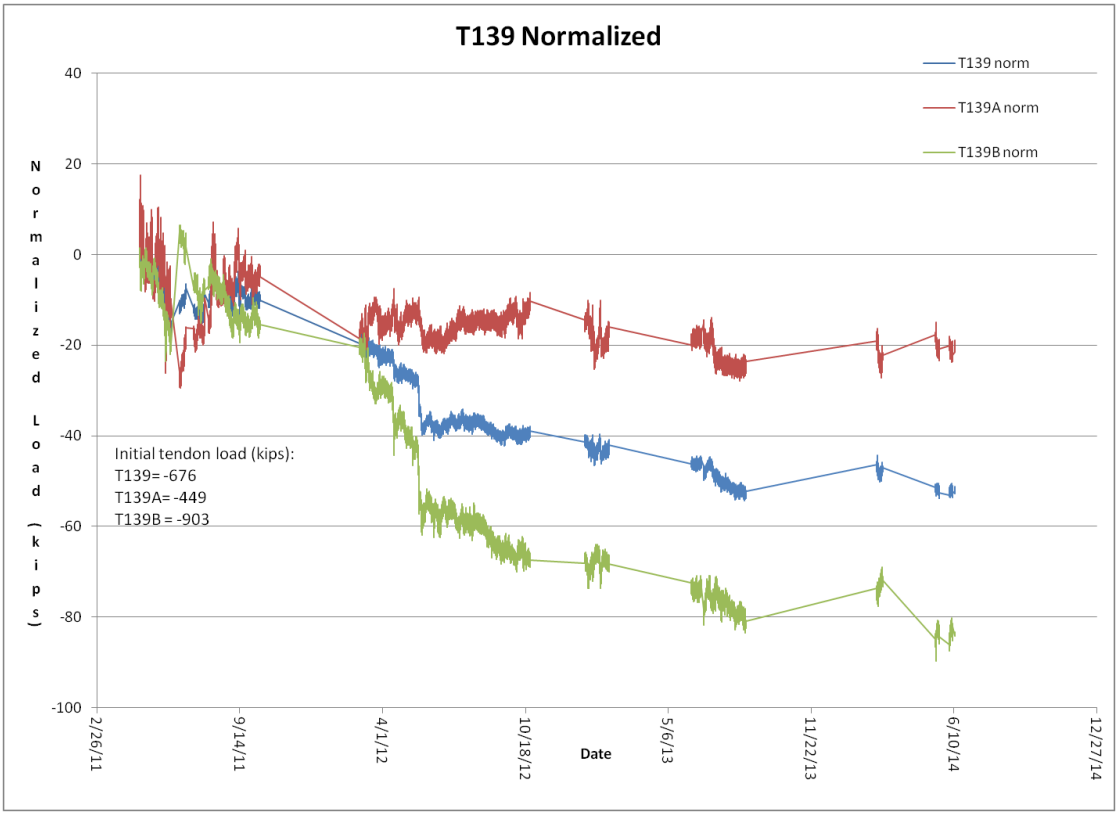

T131 Relative Temperature
T131B_TCG_A101250
T131A_TCG_A10199D
Norm_T131B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

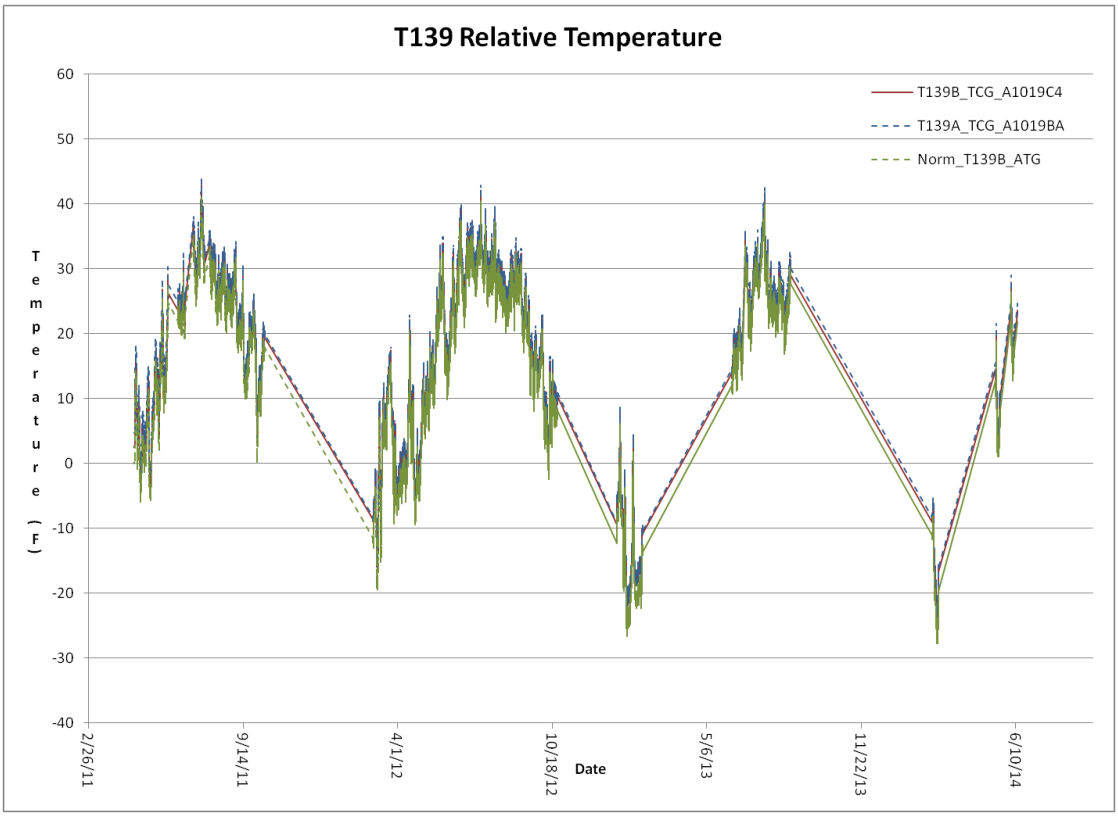

T131 Absolute Temperature
HRC_ATG
T131B_ATG_B313018
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

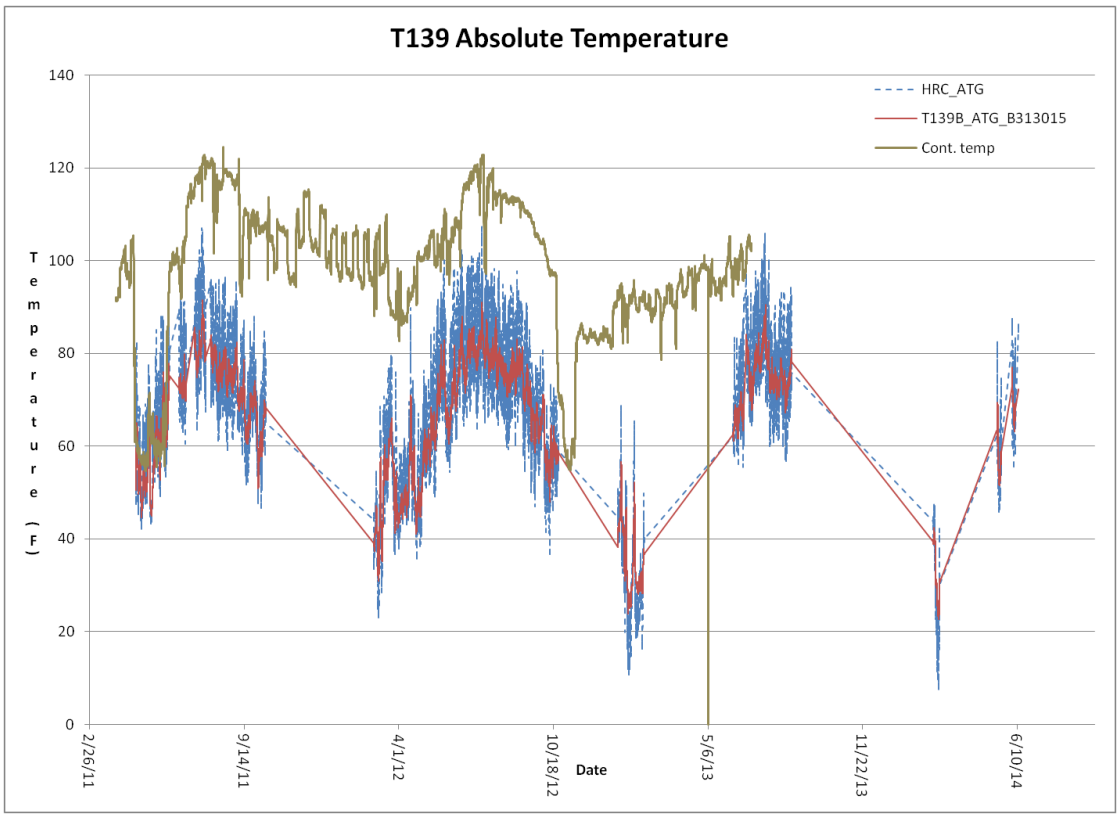
Tendon 139


T139
HRC_ATG
T139B_ATG_B313015
Cont temp
Cont Pres
T139A_TCG_A1019BA
T139B_TCG_A1019C4
T139
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-660
-680
-700
-720
-740
-760
-780
-800
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

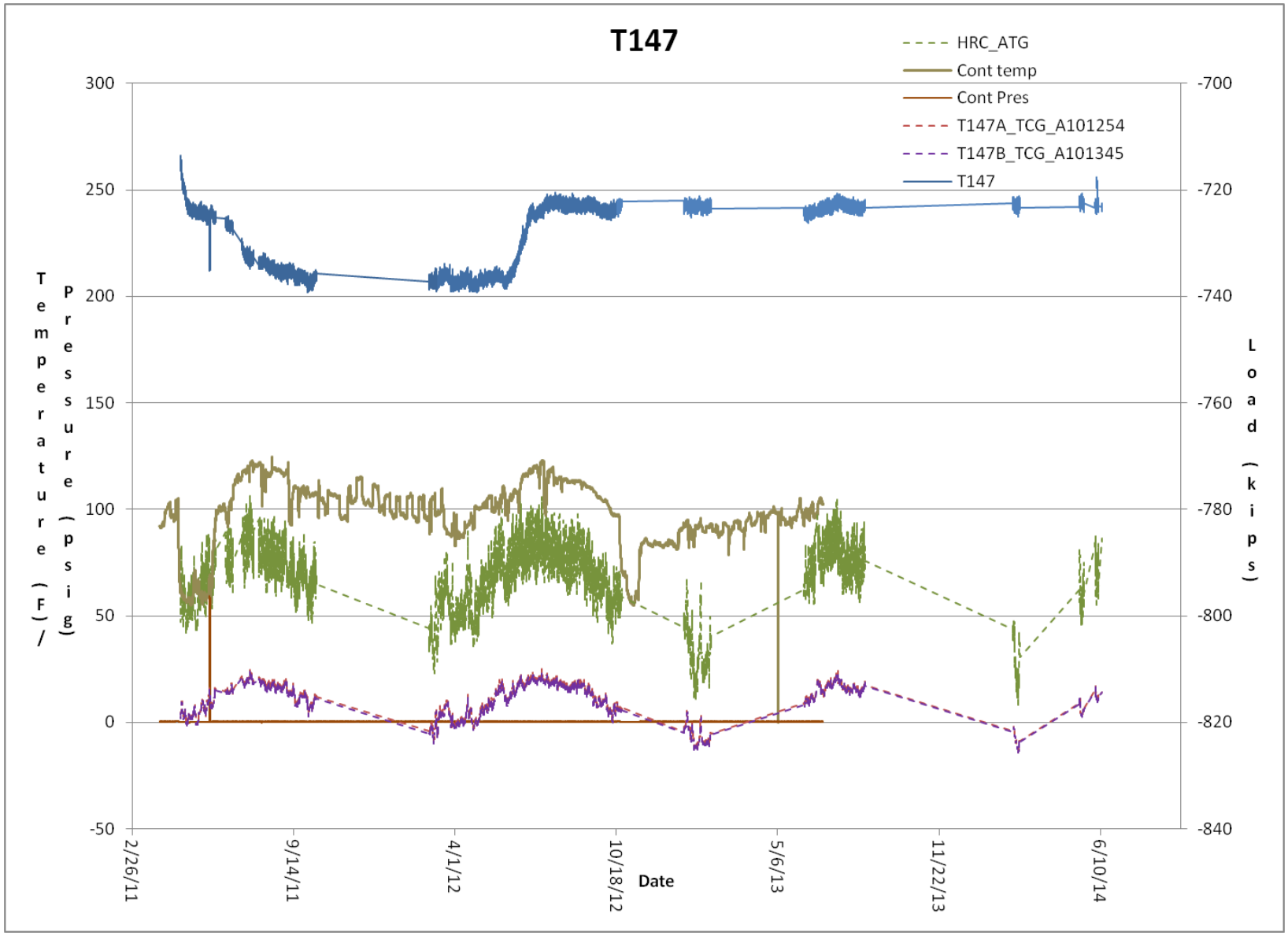

T139A and T139B
T139
T139A
T139B
Lower limit = -636 kips
Upper limit = -743 kips
Load (kips)
-300
-400
-500
-600
-700
-800
-900
-1000
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

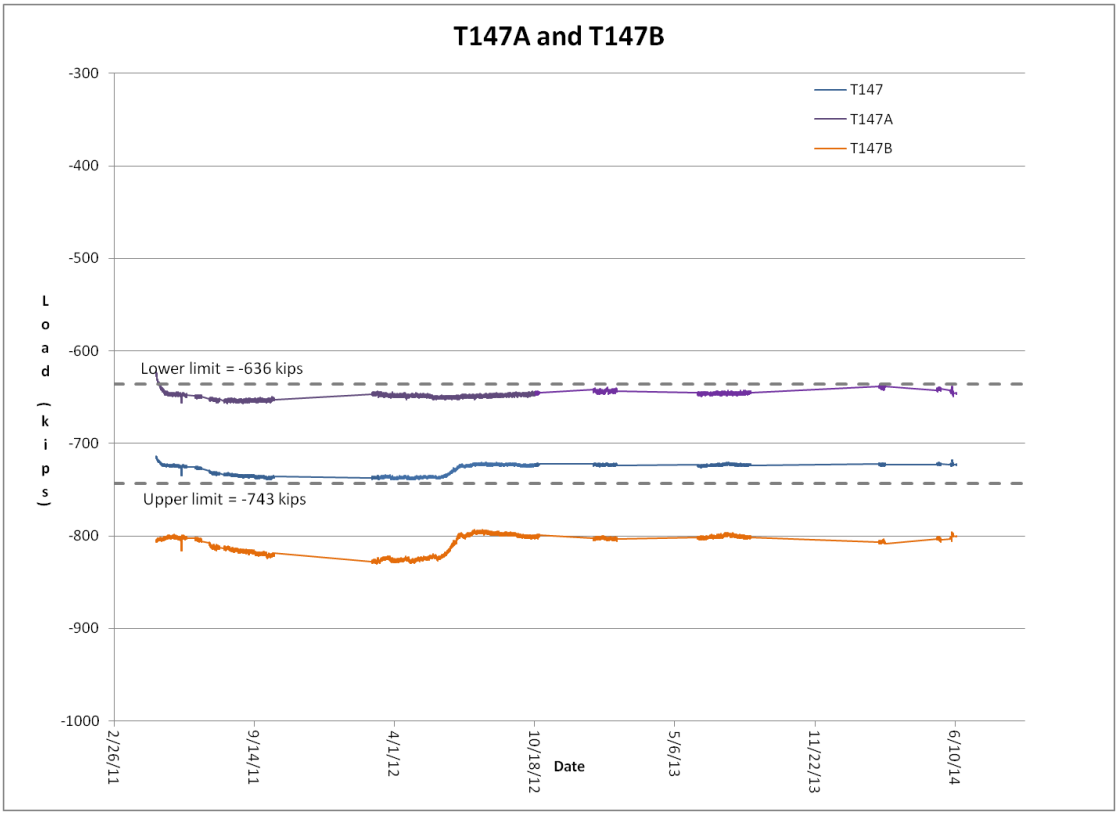

T139 Normalized
T139 norm
T139A norm
T139B norm
Initial tendon load (kips):
T139= -676
T139A= -449
T139B = -903
Normalized Load (kips)
40
20
0
-20
-40
-60
-80
-100
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

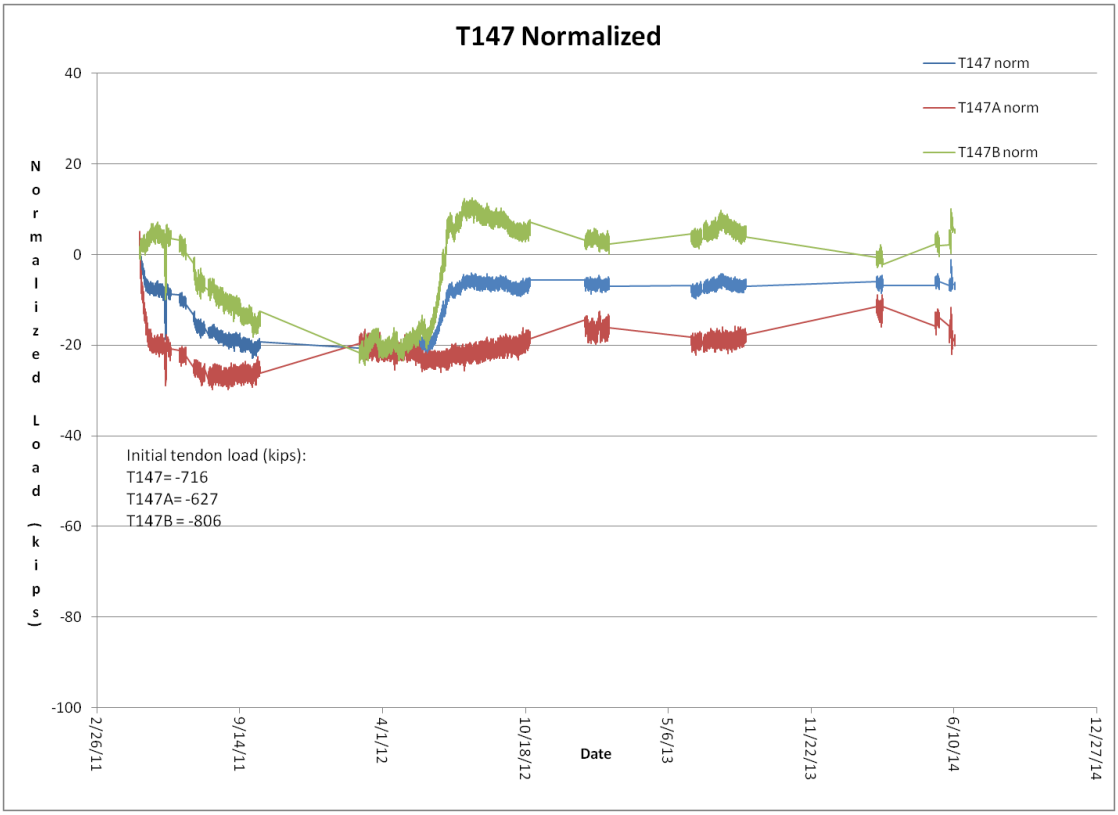

T139 Relative Temperature
T139B_TCG_A1019C4
T139A_TCG_A1019BA
Norm_T139B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

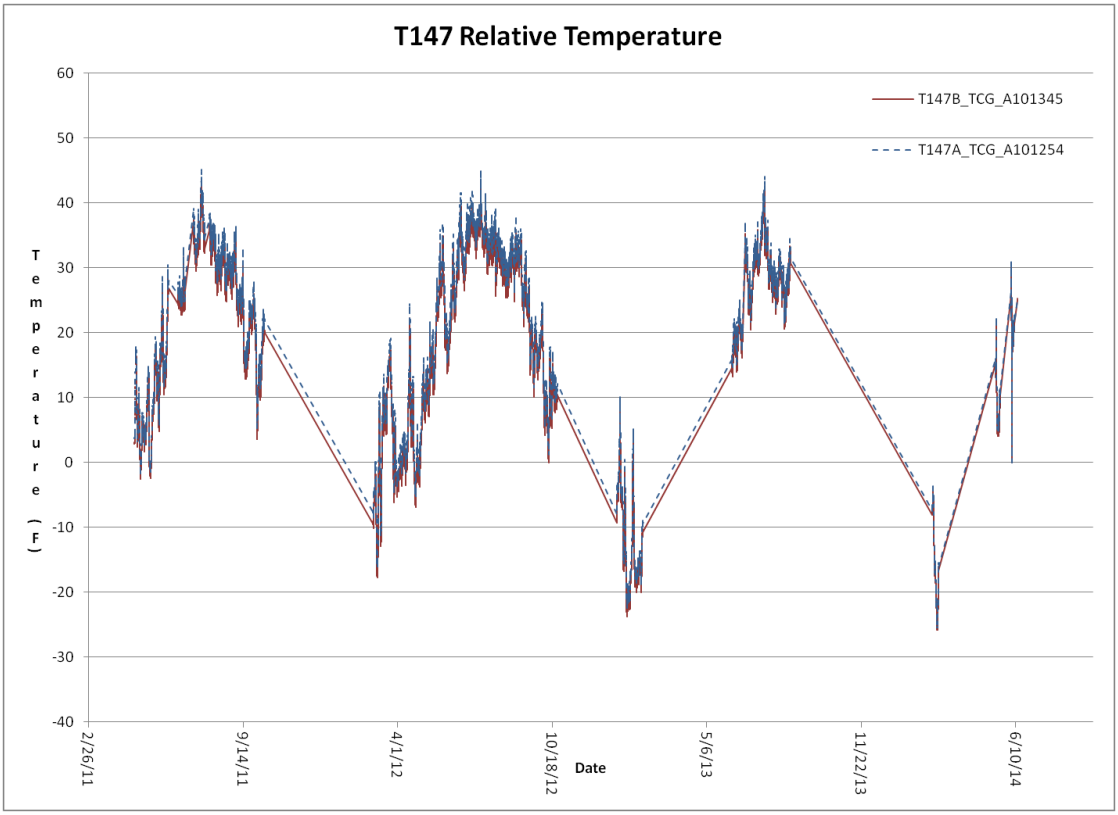

T139 Absolute Temperature
HRC_ATG
T139B_ATG_B313015
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

Tendon 147


T147
HRC_ATG
Cont temp
Cont Pres
T147A_TCG_A101254
T147B_TCG_A101345
T147
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-700
-720
-740
-760
-780
-800
-820
-840
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

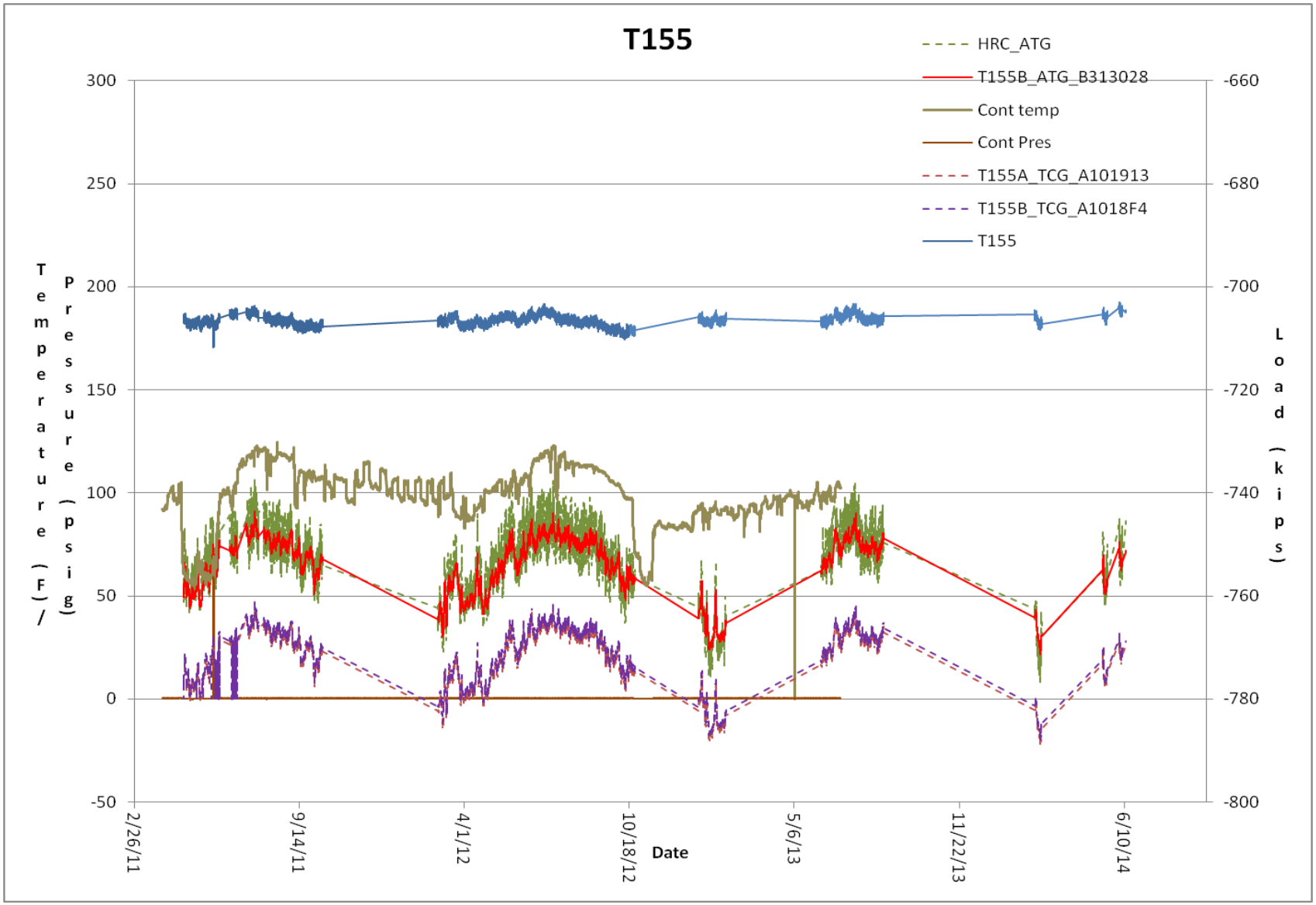

T147A and T147B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T147
T147A
T147B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

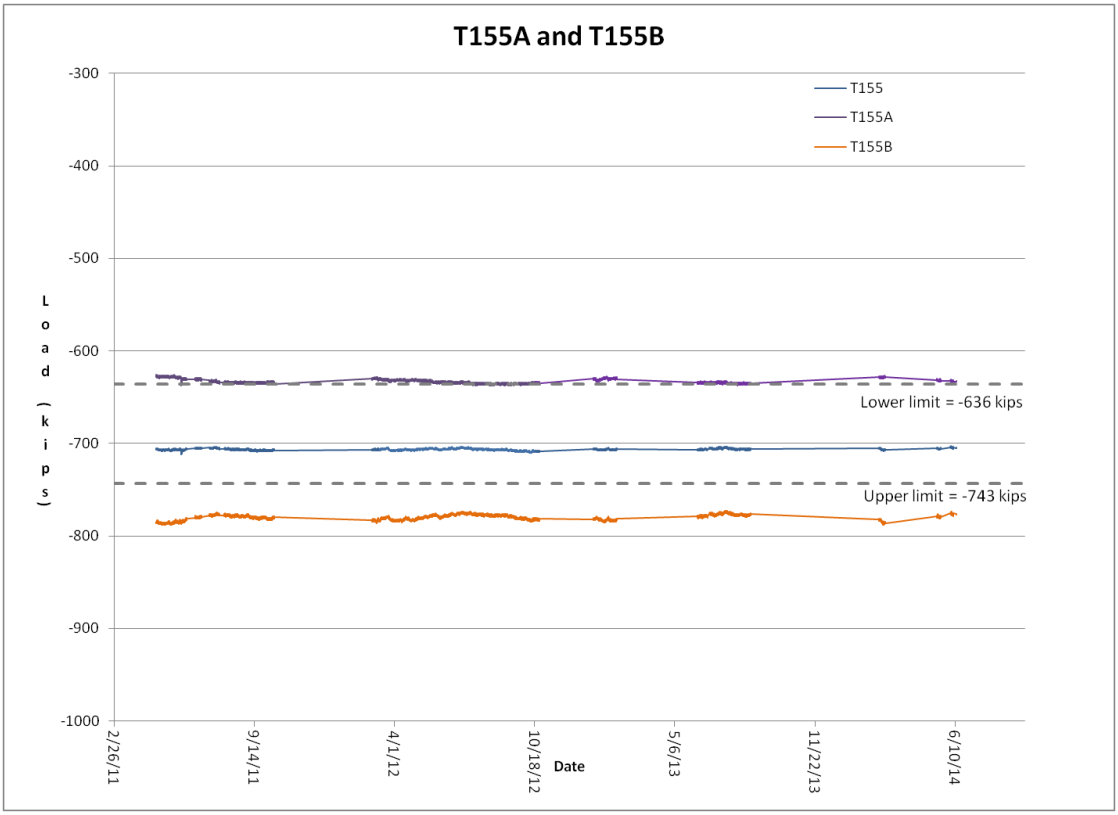

T147 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T147 norm
T147A norm
T147B norm
Initial tendon load (kips):
T147= -716
T147A= -627
T147B = -806
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date

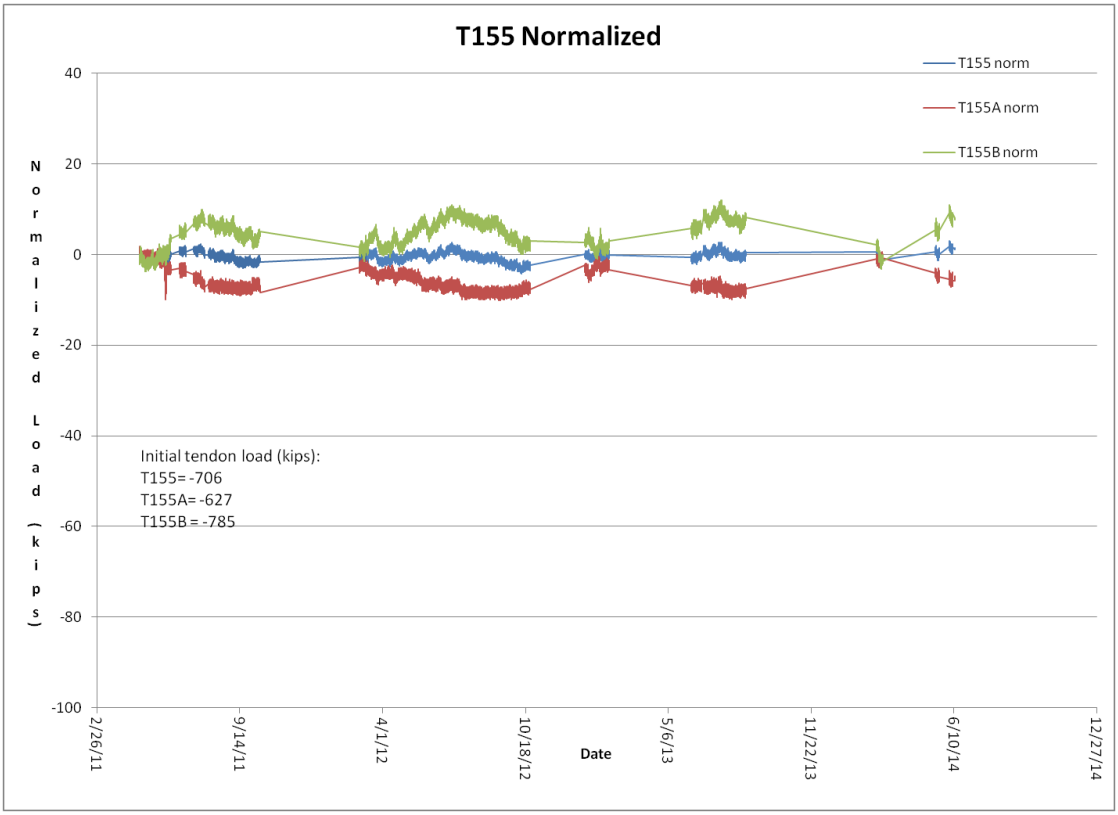


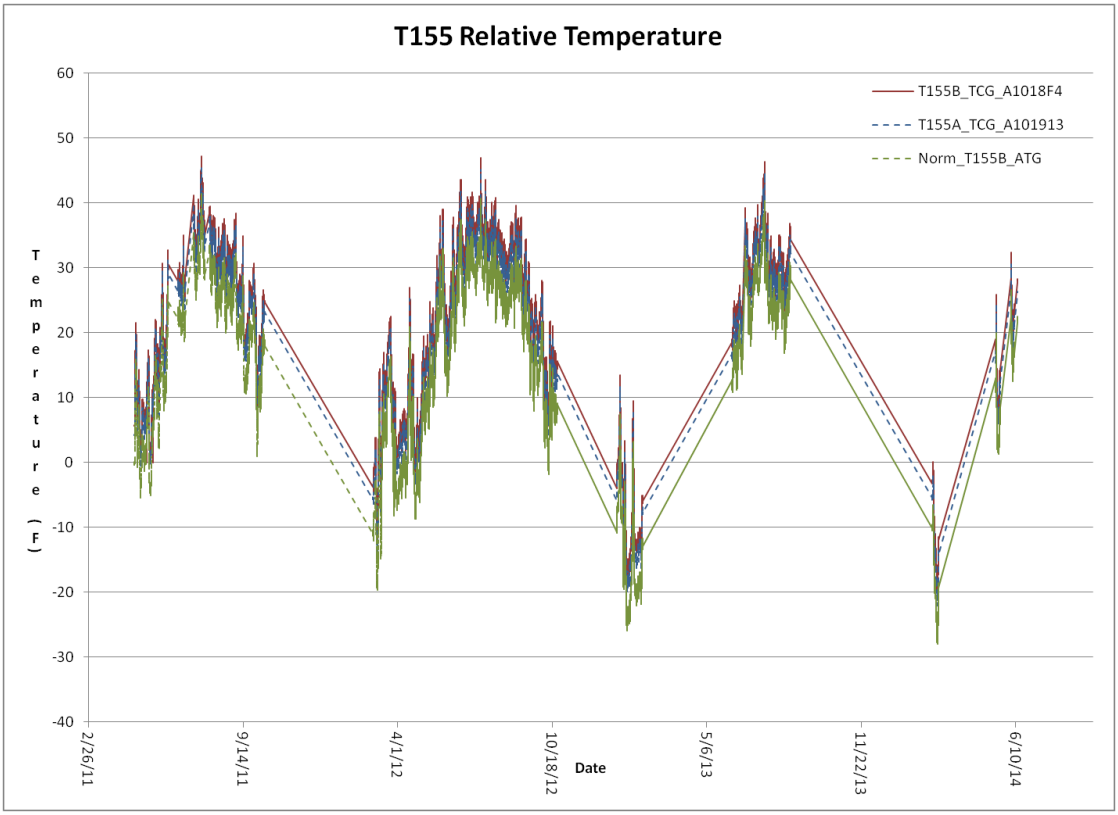
Note: T147 Absolute Temperature Gage (ATG) is not functional.

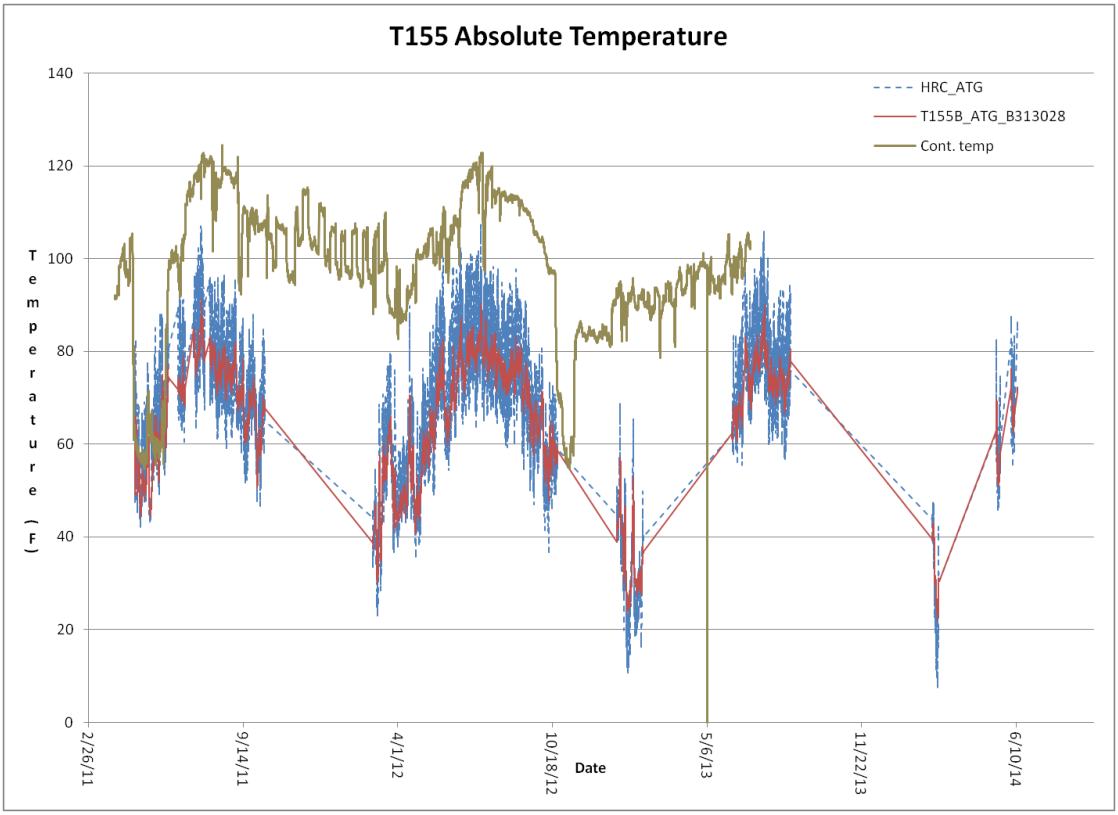
Tendon 155


T155
HRC_ATG
T155B_ATG_B313028
Cont temp
Cont Pres
T155A_TCG_A101913
T155B_TCG_A1018F4
T155
Temperature (F) / Pressure (psig)
Load (kips)
300
250
200
150
100
50
0
-50
-660
-680
-700
-720
-740
-760
-780
-800
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date


T155A and T155B
-300
-400
-500
-600
-700
-800
-900
-1000
Load (kips)
T155
T155A
T155B
Lower limit = -636 kips
Upper limit = -743 kips
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date


T155 Normalized
40
20
0
-20
-40
-60
-80
-100
Normalized Load (kips)
T155 norm
T155A norm
T155B norm
Initial tendon load (kips):
T155= -706
T155A= -627
T155B = -785
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
12/27/14
Date


T155 Relative Temperature
T155B_TCG_A1018F4
T155A_TCG_A101913
Norm_T155B_ATG
Temperature (F)
60
50
40
30
20
10
0
-10
-20
-30
-40
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date


T155 Absolute Temperature
HRC_ATG
T155B_ATG_B313028
Cont. temp
Temperature (F)
140
120
100
80
60
40
20
0
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date

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